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On Plate I facing page 73 'Photo by C. Diaz' *substitute* 'Photo by C. Diaz; Radiograph by D. S. Nayler, I.M.D.,'

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On page 549 'Glangula hyemalis' *substitute* 'Clangula hyemalis,'

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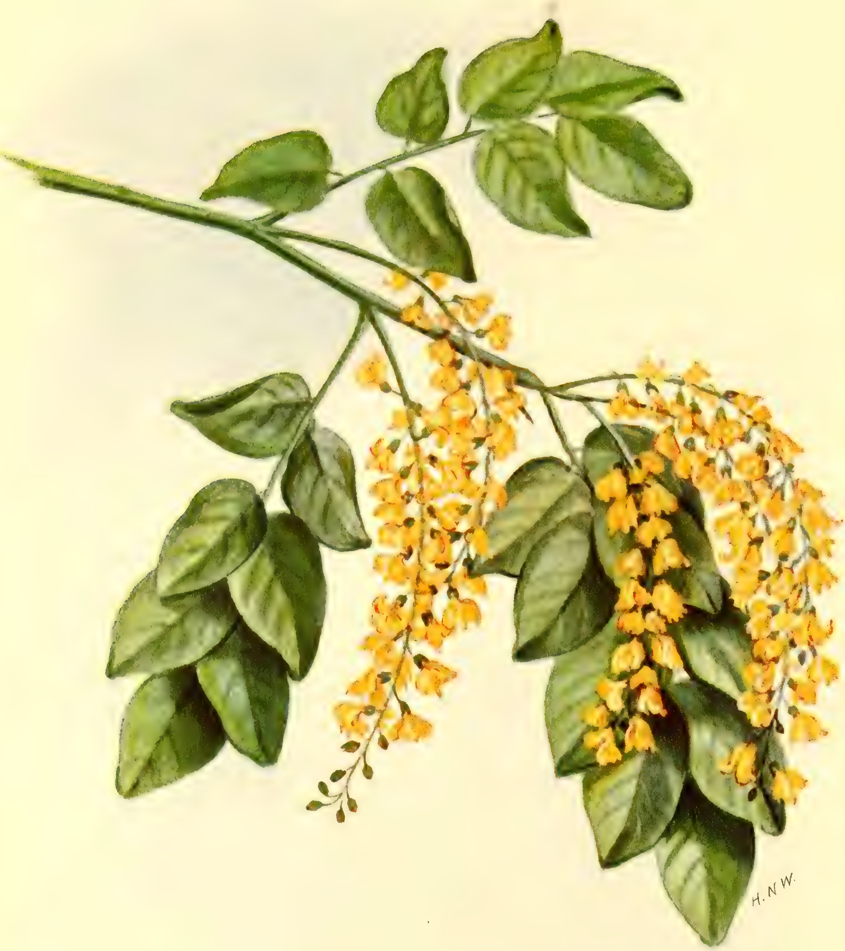

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THE PADAUK.

Pterocarpus indicus, Willd.

(about 1/3rd nat. size.)

JOURNAL

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DEC. 1936. VOL. XXXIX. No. 1.

SOME BEAUTIFUL INDIAN TREES.

BY

THE LATE E. BLATTER, S.J., Ph.D., F.L.S.,
and W. S. MILLARD, F.Z.S.

PART XXI.

(*With one coloured plate and two black-and-white plates*).

(*Continued from page* 417 *of volume* xxxviii).

THE PADAUK.

Popular Names: *Padauk* (Burma); *Padauk* (Malay).

Though commonly referred to as the Padauk in towns and stations, this is not the true Padauk of Burma which is *Pterocarpus macrocarpus* Kurz.

Pterocarpus indicus Willd. ed. sp. iii, 904. Belongs to the family *Leguminosae*. The generic name derived from the Greek means winged fruit, and refers to the condition of the pods produced by trees of the genus.

Description: The tree grows to a height of 50 ft. It has a straight trunk with smooth olive-coloured bark and a wide crown of dark green foliage and wavy drooping branches. The branches are few and tend to form low on the comparatively short bole. The leaves 8-10 in. long grow alternately on the branches. Each leaf is composed of 8-10 leaflets arranged alternately on the stalk. The leaflets are from 3-4 in. long and 2-2½ in. broad. They are glossed on both sides, oval, with smooth margins and notched at the apex, their stalks smooth, slightly channelled and flexuous. Early in the rains the tree is covered with clusters of fragrant deep orange or yellow flowers. They grow in single or compound racemes from the joints of the branchlets while single racemes form a much larger panicle at the ends of the branchlets. The flower has a short five-toothed calyx, the two upper lobes being larger than the rest. The petals comprise an erect, wrinkled, claw-like banner petal flanked by two curly wing petals of the same colour and two smaller, paler and less curly keel petals. The ten stamens are united to form two equal bunches of five, capped

JAN 26 1937

by small, two-lobed deep yellow anthers, the style is shorter than the stamens and the stigma acute. The pod is 1-2 in. in diameter. It is round and wrinkled, very tough and woody, its central part containing one, rarely two brown smooth and shining seeds.

Flowering and fruiting: The flowers appear in two or three separate flushes early in the rainy season, about May to July and the pods ripen in the cold season, about January and February (Troup).

Mr. R. H. Macaulay of Wallace Bros. & Co. (Bombay-Burma Trading Corporation), writes as follows: 'The peculiarity of the tree is that all the Padauk trees burst into flower on the same day. If I saw a Padauk in flower in the bungalow compound, I was sure to see Padauks in flower all the way down to my office in Rangoon. I think the flower did not last long and fairly soon the trees flowered again. The Burmans used to say that the rains would not come until the Padauk had flowered three times.'

The flowers are so short-lived that it has been with much difficulty that we have been able to obtain a coloured sketch of this tree.

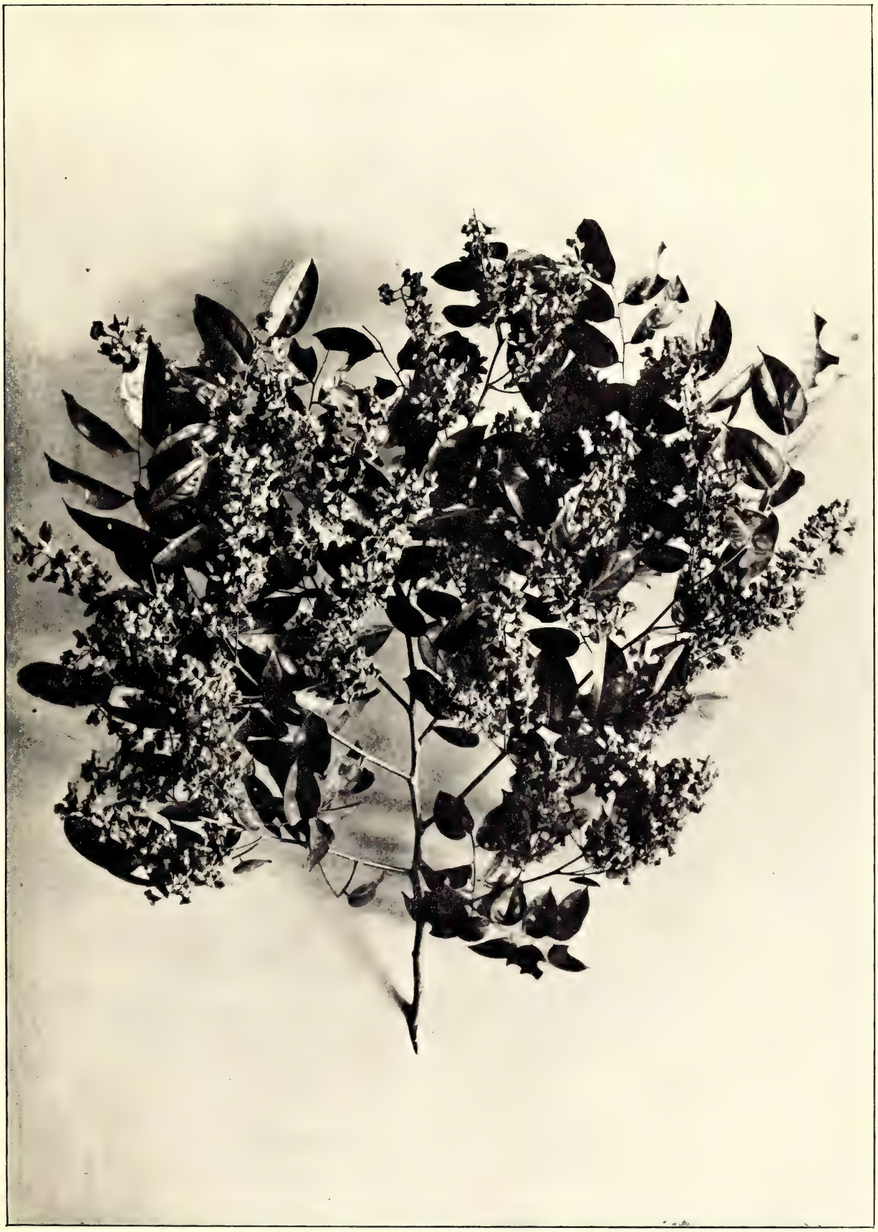
Distribution and habitat: This tree is believed to be indigenous in the Malay Peninsula and Archipelago, whence it has been introduced into Burma, where it is largely planted in gardens and along roadsides and avenues in the damper parts of the country. It has also been planted to a small extent about Calcutta and Madras. More recently it has been introduced into Bombay, where it promises to do well (Troup).

This tree was first introduced into Bombay by Mr. Justice (afterwards Sir Edmund) Fulton, I.C.S., who sent three or four young trees from Rangoon to Mr. W. S. Millard about 1906. These were all planted and have flourished, the one planted in the University Gardens flowering each year in the month of May. There are a considerable number of these trees growing in and around Bombay now.

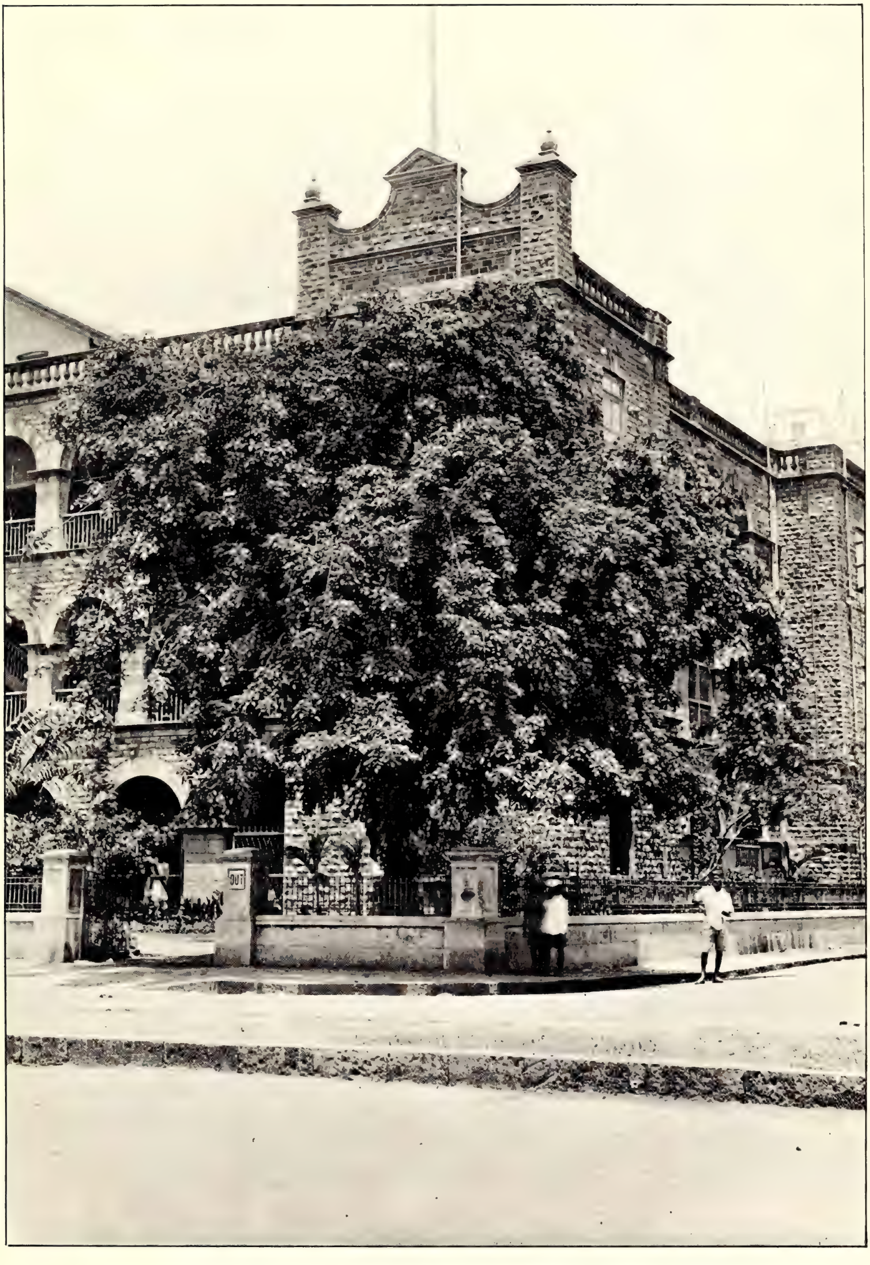
Uses: In Burma it is not important as a timber tree, but is largely planted for shade and ornament, the tree being in full foliage during the hot weather when shade is most required.

Gardening: The tree may be propagated from seed; loose soil and protection from sun favour the early development of the seedling, but the seedlings are very sensitive to frost and do not survive when frosts are prevalent. The tree thrives best in a tropical climate with a rainfall of not less than 60 in. It requires a deep well-drained soil and does not thrive on stiff clay. The tree is commonly propagated by large cuttings which should be planted in prepared pits in rather sandy soil early in the rainy season, or, if watering can be carried out, about the month of February. Nursery-raised plants are ready for transplanting at the commencement of the second rains, when they are rather more than one year old: planting can be most successfully carried out by transferring the seedlings to bamboo baskets during the first rains and planting them out in the baskets during the second rains (Troup).

(*The end*).



Flowering spray of the Padouk (*Pterocarpus indicus*).



The Padouk Tree, *Pterocarpus indicus* (Ballard Estate, Bombay).

THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.

(ORNITHOLOGICAL SECTION).

BY

HUGH WHISTLER, M.B.O.U., assisted by N. B. KINNEAR, M.B.O.U.

PART XV.

The MS. of this Part was received too late for inclusion in this number. It will appear in the next issue.—EDS.

THE ORNITHOLOGY OF TRAVANCORE AND COCHIN.

BY

SÁLIM ALI.

With Notes by HUGH WHISTLER.

PART VI.

(*With one Plate*).

(*Continued from page* 790 *of volume* xxxviii).

SUB-ORDER: CUCULI.

FAMILY: CUCULIDÆ.

Cuculus canorus subsp.? The Cuckoo.

Not met with by the Surveys. I have seen a specimen in the Trivandrum Museum marked '♂ 27-7-77' presumably from Travancore, but without locality. Ferguson (*J.B.N.H.S.*, xv, 664) refers to another shot in Trivandrum in February 1893 which is apparently not in the museum now. He describes the bird as a rare winter visitor to Travancore. The race is indeterminate.

[I have no information beyond the above record of Ferguson's. There appear to be only three or four records from Ceylon and so far as I am aware, the race represented by those specimens has not been properly verified. —H. W.]

Cuculus micropterus micropterus Gould. The Indian Cuckoo.

Specimen collected: 458 ♀ 17-3-33 Rājampāra 1,350 ft.

Elsewhere not noted. Heard at Trivandrum, but either this or *Penthoceryx?*

Colours of bare parts: Iris brown; gape and rim round eye (eyelids) bright lemon yellow; bill, upper mandible horny-brown, lower mandible greenish-brown, yellow at chin; mouth yellowish-pink; legs and feet yellow; claws horny-brown.

[The specimen measures: Bill 28.5; wing 190.5; tail 148 mm. No other Travancore specimens seen. The few South Indian and Cinghalese specimens that I have seen appear to be identical with Himalayan birds, but more breeding material is required before the point can be definitely settled.—H. W.]

Ferguson's remarks (*J.B.N.H.S.,* xv, 664) imply that the Indian Cuckoo is a resident species in Travancore. He mentions that the only two specimens in the Trivandrum Museum in his time were shot in the low country, and that he never came across it in the hills. According to him it frequents forest, and its loud cry may be heard in April and May especially towards dusk. The Survey specimen was obtained in deciduous forest in the Panthalam Hills at about 1,500 ft. elevation. It was solitary. The well-known call, which in the light of the modern craze may be aptly syllabified as *Cross-word Puzzle* repeated *ad nauseam,* was not at all commonly heard by the end of April when the Survey concluded its field work. The species, in fact, appeared to be definitely rare, and Kinloch also does not include it in his Nelliampathies lists.

It has not been recorded from the Palni Hills and is a rare winter visitor to Ceylon.

Breeding: The specimen (17 March) was breeding. There was considerable development in its ovary, and the largest follicle measured over 11 mm. in diameter. The distended oviduct indicated that laying had commenced.

Nidification (iii, 347) records that Stewart obtained a complete oviduct egg from a female shot by him in Travancore. It was all blue of rather a grey shade. Unfortunately the date is omitted.

Hierococcyx varius Vahl. The Common Hawk-Cuckoo.

Specimens collected: 468 ♀ 19-3-33, 483 ♀ 21-3-33 Rājampāra 1,350 ft.; 593 ♂ juv. 14-4-33 Cape Comorin ca. S.L.; 790 ♂ 5-8-33 (Nettayam 200 ft.) Trivandrum Environs.

Elsewhere noted at: Marāiyūr (3,500 ft.); Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Tenmalai (500 ft.); Trivandrum Town; Balamore Estate (2,000 ft.—Ashāmbū Hills); Wadakkāncheri (400 ft.); Karūpadanna (ca S.L.).

Colours of bare parts: *Adult*: Iris greyish-yellow or yellowish-buff; rim round eyes (eyelids) and gape lemon yellow; bill yellowish-green, black on culmen and tips; mouth pink and yellow; legs, feet and claws bright chrome yellow. *Juvenile*: Iris greyish-brown; bill pale brownish-yellow; gape and mouth yellow; legs, feet and claws pale yellow.

[Measurements:

	Bill.	Wing.	Tail.	Tarsus.
1 ♂ adult	27.5	moult	164.5	21 mm.
1 ♀ adult	26	194.5	—	23 mm.
1 ♀ imm.	25.5	183	147.5	— mm.

Other specimens examined: *Brit. Mus.*: ♀ no date Mynall (Hume Coll.); o? ad. no date Aneichardi Estate (Stewart).

The moult of this cuckoo seems very irregular, some feathers being moulted and others not, so that old and new feathers mingle in the plumage both in the first year and in the adult. Curiously enough this reminds one of the case of its favourite host *Turdoides somervillei*.—H. W.]

In the Travancore-Cochin area the Hawk-cuckoo is a common, generally distributed and obstreperous species in the low country, and through the foothills up to an elevation of about 1,000 ft. In smaller numbers it was met with up to at least 3,500 ft. Curiously enough Kinloch says (*J.B.N.H.S.*, xxvii, 940) that it does not occur in the Nelliampathy Hills at any season.

It frequents well-wooded country, gardens and groves of trees, near cultivation and human habitations as well as away from them. I never met the bird actually within evergreen forest. Its *Brain-fever* calls were heard all day long and often far into, or even throughout moonlit nights. They are usually uttered five or six times in succession, rising in a crescendo and ending abruptly, and are repeated with monotonous persistency.

According to Fairbank (*S.F.*, v, 397) the Hawk-cuckoo is common in the Palni Hills both at the base and higher up. Its status in Ceylon is uncertain. Legge considered it a winter visitor, but as the birds call incessantly throughout that period, and as Wait considers that some breed on the island, it may well be that the typical race as a migrant and a local race as a resident both occur. The only two specimens Mr. Whistler has examined from Ceylon seem darker than continental birds. The point requires investigation by workers in Ceylon.

Breeding: In specimen No. 483 (21 March) the ovary was distinctly granular and the follicles appeared to be enlarging. Some of them measured about 1 mm. in diameter. No. 593 (14 April) was a juvenile, just growing wing and tail quills. The forest-guard, who found it and brought it in alive, said it was being fed by 'other birds' (probably babblers), but on cross-examination supplied a highly colourable description of a woodpecker! The young uttered *Kē-kē* from time to time, very like that of *Turdoides somervillei* but somewhat high-pitched.

Cacomantis merulinus passerinus (Vahl.). The Indian Plaintive Cuckoo.

Specimens collected: 618 ♀ ad. (hepatic) 18-4-33 Arāmboli 250 ft.; 894 ♀ imm. 24-11-33 Wadakkāncheri 400 ft.

Elsewhere not noted.

Colours of bare parts: Iris in 618 (hepatic) chestnut brown, in 894 (imm.) pale brown; bill horny-brown, paler at chin and basal part of lower mandible; mouth bright orange-brick; gape in immature (894) orange; legs and feet brownish-yellow; claws horny-brown.

[Measurements:

	Bill.	Wing.	Tail.
1 ♀ ad.	23	113.5	104.5 mm.
1 ♀ juv.	22.5	113	114.5 mm.

No other Travancore specimens seen.—H. W.]

The Indian Plaintive Cuckoo is apparently an uncommon (resident?) species in Travancore and Cochin. It was met with singly in the low country, in fairly dry scrub-and-bush jungle and light deciduous forest about cultivation, and was silent. The Trivandrum Museum in Ferguson's day contained only two specimens both shot in April in forest in the low country (*J.B.N.H.S.*, xv, 664).

It is a winter visitor to Ceylon.

Breeding: Nothing appears to be recorded from our area. Beyond the fact that No. 894 (24 November) was immature with an imperfectly ossified skull, no other evidence was obtained by the Surveys.

Penthoceryx sonnerati [sonnerati Latham]. The Banded Bay Cuckoo.

Not procured by the Surveys, but calls similar to those of *Cuculus micropterus*—in a higher key—heard in Trivandrum town and at Rājampāra presumably emanated from this species. We also have a sight record from Arāmboli, 18-4-1933. Ferguson (*J.B.N.H.S.*, xv, 664) merely states that it is decidedly rare in Travancore, and this we can confirm. Though probably a resident species, nothing is recorded about its breeding in our area.

Surniculus lugubris lugubris (Horsfield). The Indian Drongo Cuckoo.

Specimens collected: 311 ♀ 19-2-33 Kōttayam ca. S.L.; 961 ♀ 9-12-33 Nemmāra 300 ft.

Elsewhere noted at: Rājampāra (1,350 ft.—Panthalam Hills).

Colours of bare parts: Iris brown; bill brownish-black; gape (in 961) pale dusky orange; mouth pink (in 311), pale pink and creamy-orange (in 961); legs and feet pinkish plumbeous (in 311), greyish-brown (in 961); claws horny-brown.

[Measurements:

	Bill.	Wing.	Central Tail.	Outer Tail.
2 ♀♀	23.5-24	135-137.5	127-130	146.5-152 mm.

No other Travancore specimens seen.—H. W.]

The Surveys found the Drongo Cuckoo not common anywhere in Travancore and Cochin, but generally distributed in the low and foothills country. Ferguson (*J.B.N.H.S.*, xv, 665) believed it to be a resident species. The highest elevation at which it was met with was about 1,400 ft. It affects light forest in the neighbourhood of cultivation, the cashew, jack and cocoanut gardens surrounding the backwater homesteads, and pepper plantations, usually singly. Inspite of the superficial resemblance to the drongo, its flight and habits are characteristically cuculine.[1] It was silent on the whole, the only occasion when it was heard calling being on 19 March. The call consists usually of 6, but sometimes 7 or 8, musical whistling notes as if the bird was actually counting 1-2-3-4-5-6 etc. The whistles rise in scale and end abruptly, but the bird begins again after an interval of a few seconds. When perched silently the body is held erect and the resemblance to the drongo is then accentuated. When calling, however, the bird assumes a horizontal axis.

Its occurrence in the Palni Hills is unknown. It is a resident in Ceylon.

Breeding: The ovary of the specimen was in a quiescent state. *Nidification* (iii, 355) gives the breeding season in Travancore as January to March. J. Stewart is said to have taken an egg from a nest of the Black-headed Babbler (*Rhopocichla a. bourdilloni*).

Clamator jacobinus jacobinus (Boddaert). The Pied Crested Cuckoo (olim *taprobanus*. See Eastern Ghats Survey, *J.B.N.H.S.*, xxxvii, 523).

Specimens collected: 528 ♀ 7-4-33 Cape Comorin ca. S.L.; I have seen two specimens in the Trivandrum Museum labelled: o? 21 and 22 Sept. 1898—Kūttyāni.

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[1] [A good deal is usually made of the resemblance of this cuckoo to a drongo and many writers tend to assume that it must therefore lay in drongos' nests. They do not, however, make the logical extension of the idea to *Hierococcyx* and *Cuculus* and suggest that they lay in hawks' nests! It should be remembered also that in Africa the drongo *Dicrurus ludwigi* has a close resemblance to the Black Flycatcher (*M. pammeliana*).—H. W.]

Elsewhere noted at Arāmboli (250 ft.).

Colours of bare parts: Iris brown; bill horny black; mouth pink; legs and feet brownish-slate; claws horny black.

[Measurements:

	Bill.	Wing.	Tail.	Tarsus.
1 ♀	25.5	143	150	26 mm.

No other Travancore specimens seen.—H. W.]

The Travancore Survey only came across this cuckoo in the low country about Cape Comorin and Arāmboli in the extreme south of the State, where it was fairly common. It inhabits lightly wooded and Babūl scrub terrain, and groves of trees in the neighbourhood of cultivation. According to Ferguson (*J.B.N.H.S.*, xv, 665) it is resident in Travancore.

Neither Fairbank nor Terry's lists from the Palni Hills include this cuckoo and its occurrence and status there needs to be determined. This form (typical) is resident in Ceylon.

Breeding: In the first half of April breeding was certainly in progress. Birds were constantly observed chasing one another and calling *Pee-pee* etc. One such party consisted of 8 birds which were very noisy. They were in a patch of open Babul scrub jungle where babblers (*Turdoides striatus*) were nesting.

The ovary of the specimen (7 April) was fully mature and contained soft eggs. On the same date a juvenile, lately out of nest, was observed being tended by a pair of White-headed Babblers. On the approach of the foster parents, the cuckoo shivered with partially outstretched wings and excitedly clamoured for food.

Clamator coromandus (Linnaeus). The Red-winged Crested Cuckoo.

Specimen not obtained. The Travancore Survey came across this cuckoo on three or four occasions among the scrub and bushes bordering the steep banks of the Periyār River at Thattakād (ca. 200 ft.). It was always single, and silent. There is a specimen in the Maharaja's College Museum at Ernākulam (Cochin State) collected in that neighbourhood.

According to Ferguson (*J.B.N.H.S.*, xv, 665) this cuckoo is a rare winter visitor to the hills and he refers to two specimens then in the Trivandrum Museum, shot at 2,500 and 4,000 ft. respectively in South Travancore.

It is said to be common in Ceylon.

Eudynamis scolopaceus scolopaceus (Linn.). The Indian Koel.

Specimen not obtained.

Noted at: Marāiyūr (3,500 ft.); Thattakād (200 ft.); Kōttayam (ca. S.L.); Mūndakāyam and Ūrūmbikera Reserve Forest (ca. 1,000 ft.); Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Shōranūr; Nemmāra (300 ft.); Karūpadanna (ca. S.L.).

Excepting at Marāiyūr, the Koel was chiefly met with by the Surveys below an elevation of about 1,000 ft., and more especially in the low country. It is not common in the Travancore-Cochin area. According to Ferguson (*J.B.N.H.S.*, xv, 665) it is a resident species in Travancore and may occasionally be found in the hills. Kinloch (*J.B.N.H.S.*, xxvii, 939), however, includes it amongst the birds that are not found in the Nelliampathies at any season. I think its altitudinal as well as local status is largely co-ordinated with that of the crows, especially *Corvus splendens*, upon the nests of which it is habitually parasitic.

Fairbank (*S.F.*, v, 397) observed the Koel a few times in the Palni Hills, at what elevation is not stated. The typical race also occurs in Ceylon.

Breeding: There are no published records of its breeding in Travancore or Cochin. The Surveys obtained no precise data on this point apart from the fact that at Karūpadanna, House Crows were breeding in the second half of December, and as the Koels then were very excited and obstreperous they were presumably busy cuckolding them.

Rhopodytes viridirostris (Jerdon). The Small Green-billed Malkoha.

Specimens collected: 88 ♀ 14-1-33 Maraiyūr 3,500 ft.; 595 ♂ 15-4-33 Arāmboli 250 ft.

Elsewhere not noted.

Colours of bare parts: Iris fine outer ring white, inner claret; bill greyish-green; mouth brownish-black; wattly circumorbital skin pale blue; legs and feet greyish-slate or 'pale bluish-green, shading into greenish-blue' (Humayun and Pillai).

[See my note in the Eastern Ghats Survey Report (*J.B.N.H.S.*, xxxvii, p. 525) on the differences of white tips of tail feathers in Ceylon and South Konkan. Travancore birds lie between these extremes, but are closer to Ceylon.

I have seen five other Travancore specimens in the British Museum but with no very precise data.

In the juvenile bird the first primary is softer, broader and more rounded, as compared with the sickle-shaped first primary of the adult. The tail-feathers are narrower and the central pair have a very narrow brownish and white tip. The post-juvenal moult is complete. The post-nuptial moult is complete, and apparently there is no spring moult.—H. W.]

The Small Malkoha was met with by the Surveys only in the above two localities, where it seemed to be fairly common. It inhabited lightly wooded and scrub country of the deciduous type, and was seen either singly or in pairs. It undoubtedly prefers the broken foothills country, but Ferguson (*J.B.N.H.S.*, xv, 665) once obtained it at Peermade at about 3,000 ft. elevation.

Fairbank (*S.F.*, v, 397) saw four at different times in the thickets at the eastern (dry) base of the Palni Hills. In Ceylon it occurs in the low country up to about 1,000 ft. elevation.

Breeding: The gonads of the specimens were undeveloped. On 19 April one of these Malkohas was observed building a fairly untidy saucer-shaped nest of thorny green twigs—some with leaves still attached. The site was about 4 ft. up in a cactus (*Euphorbia*) hedge, in broken scrub country at the foot of the hills in the Arāmboli Gap. The twigs were being plucked from a living tree some 20 yds. away, and only one of the birds was engaged in the work. On visiting the nest again on 28 April, Humayun found it to contain 2 eggs which he took. The eggs, white in colour, measured 27 × 22 and 27 × 21 respectively.

[**Phœnicophaus pyrrhocephalus** (Pennant). The Red-faced Malkoha.

Not met with by the Surveys. The *Fauna* (iv, 182) as well as *Nidification* (iii, 364) confidently mention that this Malkoha, hitherto considered strictly endemic to Ceylon, occurs in the extreme south of Travancore, where Stewart is said to have obtained it. Stewart's record or records, if authenticated by skins seem remarkable. Concerning the habits of this bird in its native island, Wait writes that it is very shy and haunts the wilder stretches of forest away from cultivation. The 'extreme south of Travancore' is particularly dry country compared with the rest of the State, and well outside the influences that conduce to the growth of dense forest elsewhere. On the face of it, therefore, the locality is physiographically an unlikely place to find this forest-loving Malkoha in, unless it has completely changed its habits upon setting foot on the mainland! It would be interesting to learn what exact locality Stewart obtained his specimens in and also some ecological details of the place.

With regard to the taking of its eggs in Travancore in April and May by Stewart (*Nidification*), these records should, I think, be accepted with a double dose of caution in view of what is said above, and also of the ever-present possibility of their vicariousness unless supported by the skins of the birds that laid them.]

Taccocua leschenaultii leschenaultii Lesson. The Southern Sirkeer Cuckoo.

Specimen collected: 408 ♀ 6-3-33 Kūmili 3,000 ft.

Elsewhere noted at: Maraiyūr (3,500 ft.); Arāmboli (250 ft.).

Colours of bare parts: Iris brown; bill cherry red, yellow at tips and brown along commissure; mouth slaty-black; legs and feet slaty; claws horny brown.

[The specimen measures:

Bill.	Wing.	Tail.
31.5	151	226 mm.

No other Travancore specimens seen except one 'Anjango' bird.—H. W.]

The Sirkeer Cuckoo is, on the whole, uncommon in Travancore. The Surveys failed to come across it in Cochin whence Kinloch likewise does not include it in his Nelliampathies list. It was observed singly or in pairs amongst undergrowth of tall grass and scrub in deciduous forest. At Arāmboli, where it was perhaps less rare than elsewhere, it frequented thin forest and scrub on the sides of the broken stony hills. At Maraiyūr an example was picked up dead and mutilated in an abandoned forest clearing with much undergrowth —possibly the work of a mongoose.

There is no published record of its occurrence in the Palni Hills, but it doubtless does so in suitable dry facies on the eastern slopes. It is a local resident in Ceylon.

Breeding: The specimen (6 March) had some of its ovarian follicles over 1.5 mm. in diameter. It was one of a pair and about to breed as was evident from the courtship in which it was engaged when shot. The display consisted of bowing (or bobbing) and posturing in ludicrous fashion, tail spread out and partly cocked, before the other of the pair. It is interesting to note that the advances in this case were being made by the female, the cock (? presumably—) though not altogether unresponsive, behaving in a much more passive and dignified manner!

On 17 April (Arāmboli) a bird was flushed off a nest in a cactus (*Euphorbia*) bush, about 10 ft. up, growing on a sparsely scrub-covered stony hillside. The nest was a shallow saucer-like structure of thorny twigs, lined with large dry leaves, and untidily wedged into a fork of the cactus. It was very similar to the Malkoha's nest. Termites had galleried up the stem of this cactus and some of their mud was actually within the nest itself. It contained two white eggs of a chalky texture—one addled, the other hard set—measuring 35 × 26 and 34 × 26 mm. respectively.

Nidification (iii, 366) records that Bourdillon obtained eggs of this cuckoo in Travancore in March and May. Two are said to form the normal clutch, but occasionally three or only a single are laid.

Centropus sinensis parroti Stresemann. The Southern Crow-Pheasant.

Specimens collected: 349 ♀ 24-2-33 Peermade 3,200 ft.; 537 ♂ 8-4-33 Cape Comorin ca. S.L.; 708 ♂ 22-7-33 (Pattom ca. 50 ft.); 782 ♂ 4-8-33 (Cattle Farm) Trivandrum Environs; 1031 ♀ 28-12-33 Karūpadanna ca. S.L.

Elsewhere noted at: Maraiyūr (up to 4,500 ft.); Mūnnār (5,000 ft.—Kannan Devan Hills); Sānthanpāra (3,500 ft.—Cardamom Hills); Rājampāra (1,350 ft. —Pandalam Hills); Tenmalai (500 ft.); Trivandrum Town; Arāmboli (250 ft.); Balamore Estate (2,000 ft.—Ashāmbū Hills); Kūriārkūtti (1,600 ft.—Annemalai Hills); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Pādagiri (3,000 ft.—Nelliampathy Hills); Trichur Town; Ernākulam.

Colours of bare parts: Iris 'blackish-grey' (Pillai), bright scarlet, pale claret or blood-red depending presumably on age; bill, legs, feet and claws horny-black; mouth palate slate, gullet pink or greyish-pink.

[The specimens measure:

	Bill.	Wing.	Tail.
3 ♂♂	39-41.5	173-183	197-238 mm.
3 ♀♀	39-43	186-198	243-271 mm.

Additional specimen seen: *Brit. Mus. Coll.*: ♀ 28-2-75 Colachul (Hume Coll.—H. W.]

Ferguson (*J.B.N.H.S.*, xv, 665) writes that in Travancore the Southern Crow-Pheasant is 'very abundant in the low country and about the foot of the hills'. This is its status in Cochin as well, and I can further add that it is also fairly common on the hills in both the States up to at least 5,000 ft. elevation, and possibly goes higher. It affects light deciduous jungle with tall grass and scrub undergrowth. Babool and scrub-and-bush jungle, rubber plantations and the neighbourhood of cultivation all provide suitable haunts, but as a rule evergreen forest is eschewed.

The stomachs of the specimens contained caterpillars, grasshoppers, lizards and their eggs, and also other insect remains which could not be satisfactorily identified. The intestines of one were infested with Cestode worms, a number of which have been preserved for identification.

In the Palni Hills, Fairbank (*S.F.*, v, 397) records the Crow-Pheasant from the base up to an elevation of 5,500 ft. In Ceylon it is found throughout the low country and also up to about 3,000 ft. in the hills. A closely allied species, *Centropus chlororhynchus,* also occurs in the island where it is said to be confined to the most humid districts, inhabiting deep jungle with thick tangled undergrowth.

Breeding: Of the specimens, No. 1031 (28 December) was ready to lay shortly, having a matured ovary with some of the follicles measuring over 3 mm. in diameter. No. 349 (24 February) with ovarian follicles ca. 2.5-3 mm., was evidently also preparing to breed. It was undergoing general moult—body, wings and tail—which was presumably prenuptial? In specimen No. 537 (8 April) the testes appeared to have commenced developing (?) and measured 5 × 3 mm. One of them was the normal oval, the other conspicuously kidney-shaped.

On 11 April (Cape Comorin) Humayun took a nest containing three well-set eggs. It was a large globular structure, about 12 in. in diameter, composed of strips of *Borassus* palm leaves and grass etc. placed amongst the tangle of the smaller inaccessible twigs of a thorny Babul (*Acacia*) tree, in low canopied Babul jungle. The eggs measured 37 × 30, 37 × 32 and 36 × 30 mm. respectively. During the week some half dozen recently disused nests were found in this locality, identical in structure and situation with the first and all about 12 ft. up. One contained an addled, discoloured egg.

In the Maharaja's College Museum, Ernākulam, I have seen a juvenile specimen with a stub tail, evidently hatched out in or about November.

According to the *Fauna* (iv, 193) Kinloch took eggs in the Nelliampathy Hills in early March, and Bourdillon says that they continue to lay in Travancore up to the end of August.

Centropus bengalensis (Gmel.) subsp.? The Lesser Coucal or Crow-Pheasant.

Specimen collected: 385 ♀ 1-3-33 Kūmili 3,000 ft.

Elsewhere noted at: Thattakād (200 ft.); Camp Derāmalai (3,000 ft.).

Colours of bare parts: Iris fine outer ring creamy white, irregular inner ring chestnut-brown; bill upper mandible pale brown, culmen dark brown, lower mandible pale flesh colour; mouth pink; legs and feet slaty; claws horny-brown.

[The specimen, ♀ immature, measures:

Bill.	Wing.	Tail.	Tarsus.
29.5	173	209	42.5 mm.

See Eastern Ghats Survey Report (*J.B.N.H.S.*, xxxvii, 528) to which I have nothing further to add as no other material is yet available.—H. W.]

This Coucal frequents stretches of tall grass land intermingled with fairly open deciduous secondary and scrub jungle in the hills of Travancore and probably also Cochin, where, however, neither the Survey nor Kinloch actually came across it. It is not uncommon though rather locally and patchily distributed. Single birds were usually met with. The specimen was scuttling on the ground through the rootstocks of the long grass, and was shot in the act of swallowing a *Calotes* lizard 8 in. in length, head foremost.

This species has not been recorded in the Palni Hills. The only record for Ceylon is possibly not authentic.

Breeding: The ovary of the specimen was undeveloped. No other relevant data was obtained, and there seem to be no published records of its nesting in the Travancore-Cochin area.

SUB-ORDER: PSITTACI.

FAMILY: PSITTACIDÆ.

[**Psittacula eupatria eupatria** (Linn.). The Large Ceylonese Parroquet.

Not met with by the Surveys nor recorded previously by the older observers in the Travancore-Cochin area. The *Fauna* (iv, 198), however, states that Stewart obtained it in Travancore, and further adds (p. 199) that the birds have been found breeding there in January and February. Confirmation is desirable.]

Psittacula krameri manillensis (Bechstein). The Rose-ringed Paroquet.

Specimen collected: 622 ♂ 18-4-33 Arāmboli 250 ft.

Elsewhere noted at: Kūmāragām (Vembanād Lake, near Kōttayam); Wadakkāncheri (400 ft.); Nemmāra (300 ft.).

Colours of bare parts: Iris pinkish cream colour; rim round eyes (eyelids) bright orange; bill upper mandible deep crimson, tip brownish, lower mandible horny black, crimson at chin; legs and feet dusky yellow; claws horny brown.

[Additional specimens seen:

Brit. Mus. Coll.: ♀ 16-11-78 Trivandrum (Bourdillon); also 2 Fry specimens with no precise data.

Measurements:

	Bill (from cere).	Wing.	Tail.
3 ♂♂	22-24	159-167	210-214 mm.

There is no spring moult and the post-nuptial moult is complete taking place about May and June. The young male is quite indistinguishable from the adult female and I suspect that the juvenile plumage is kept through the first winter.—H. W.]

My experience in Travancore does not bear out Ferguson's statement (*J.B.N.H.S.*, xv, 666) that the Rose-ringed Paroquet is 'very common throughout the low country'. On the contrary, the Survey found it decidedly *un*common and only in small numbers wherever occurring. In the low country of Cochin its numerical status was somewhat better, but even so the species was markedly less abundant than the Blossom-headed Paroquet.

Small parties of these birds were observed among cocoanut plantations bordering paddy-fields by the backwaters, and occasionally also in the neighbourhood of villages in the low country.

Fairbank (*S.F.*, v, 395) writes that it is common round the base of the Palni Hills and sometimes ascends the hillsides, while Terry (*S.F.*, x, 471) found it on the slopes below Pulungi. It is a common resident species in Ceylon.

Breeding: The testes of the specimen were in a quiescent state. According to Ferguson the breeding season in Travancore is February and March.

Psittacula cyanocephala cyanocephala (Linn.). The Western Blossom-headed Paroquet.

Specimens collected: 378 ♂ 28-2-33 Kūmili 3,000 ft.; 724 ♂ 26-7-33, 742 ♀ 29-7-33 (Kūttāni 300 ft.); 761 ♀ ?-8-33 (Mārūthānkūzhi 50 ft.) Trivandrum Environs.

Elsewhere noted at: Marāiyūr (3,500 ft.); Thattakād (200 ft.); Kōttayam (ca. S.L.); Periyār Lake Environs (ca. 3,000 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Trivandrum Town; Kodaiyār Lake Environs (below Balamore Estate); Chālakūdi; Wadakkāncheri (400 ft.).

Colours of bare parts: *Adult Male*: Iris yellowish-white; bill upper mandible pale orange-yellow, lower mandible blackish-brown except chin which pale flesh colour; legs and feet greenish-grey; claws horny plumbeous. *Female*: 'Bill pale lemon yellow, white at tip. Lower mandible dull whitish-grey' (Pillai).

[The specimens are in too bad a state with moult for measurements.

The adults have a complete post-nuptial moult and apparently no spring moult. The juvenile plumage appears to be kept through the first winter. In this the male and female are alike with a greenish head and no pale neck-ring. The plumage is in general duller than in the adult, with the central tail-feathers shorter and broader. The tips of the primaries are more pointed than in the adult.

The adult female differs from the adult male not only in the colour of the head and the neck-ring, but the crimson shoulder-patch is absent and the central tail-feathers are a less intense blue.—H. W.]

The Blossom-headed Paroquet is a common resident species in Travancore and Cochin, being found in well-wooded country from the neighbourhood of the backwaters, through the foothills, and up to an elevation of 3,500 ft. at least. In the hills, however, its distribution is somewhat capricious, the birds being quite inexplicably absent from areas to all appearances well suited to them. Thus, though it was fairly abundant at Kūmili, the Survey failed to note it at Peermade, Sānthanpāra or Camp Derāmalai in all of which localities the Blue-winged Paroquet completely replaced it.

It was mostly observed in deciduous forest or in the mixed type of jungle comprising both deciduous and evergreen elements. Occasionally it entered evergreen jungle to feed on the various species of *Ficus* figs. At Marāiyūr a flock of over 50 birds was seen.

At Thattakād these Paroquets were observed to feed largely on the nectar of *Erythrina lithosperma* and *Bombax malabaricum* flowers. In this quest the flowers are bitten off and dropped to the ground after the nectar has been squeezed out. Unlike other nectar-eating birds, therefore, they play little or no part in cross-pollinating them and their visits to the tree are of a purely destructive nature. Among their accustomed haunts are the mixed fruit gardens surrounding the homesteads along the backwaters. Mr. Pillai's notes suggest that they are destructive to standing paddy crops in the environs of Trivandrum.

In the Palni Hills both Fairbank and Terry describe this species as common. According to the former (*S.F.*, v, 395) it is commoner on the hillsides up to 4,000 ft. than the Rose-ringed Paroquet. Terry found it constantly feeding on the peaches in the orchards at Pulungi.

This Paroquet is locally common in Ceylon.

Breeding: The gonads of the specimens were inactive and no other evidence bearing on this aspect was obtained by the Surveys. The July-August specimens, however, were undergoing complete post-nuptial moult.

According to Ferguson (*J.B.N.H.S.*, xv, 666) it breeds in Travancore in March. In South India generally, the breeding season is said (*Fauna*, iv, 205) to be February to early April.

Psittacula columboides (Vigors). The Blue-winged Paroquet.

Specimens collected: 406 ♀ 3-3-33 Kūmili 3,000 ft.; 435 ♂, 436 ♀ 10-3-33 Camp Derāmalai 3,000 ft.

Elsewhere noted at: Marāiyūr (3,500 ft.); Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Peermade (3,200 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Balamore Estate (2,000-3,500 ft.—Ashāmbū Hills); Kūriārkūtti (1,600 ft.); Pādagiri (3,000 ft.).

Colours of bare parts: *Male*: Iris pale golden yellow; bill upper mandible bright cherry red except tip which yellowish-horn colour, lower mandible horny brown tinged with orange at chin yellowish-horn at tip; legs and feet greenish-grey; claws dark horny brown. *Female*: Iris pale lemon yellow; bill dark horny-brown tinged with orange at chin; legs, feet and claws as in ♂.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ ♀ ?-3-75 Eridge (Hume Coll.); ♂ 7-1-72 Ashambo Hills (Bourdillon); ♂o? 19-2-14 Aneichardi Estate (Stewart); ♂ 11-11-79, ♀ 8-11-78, ♂ 18-10-78 Mynall (Bourdillon).

B.N.H.S. Coll.: ♂ 19-8-93 Thēkadi (J. P. Cook).

Measurements:

	Bill (from cere).	Wing.	Tail.
6 ♂♂	22-23.5	142.5-148	206-227 mm.
1 ♀	21	135	Worn.

The adult female differs from the adult male in having the green wash on the forehead and lores reduced to a minimum; there is no ring of verditer green behind the black neck-ring; the grey of the breast is less pure in tint. In the juvenile plumage the male and female are alike. They differ from the adults in having the entire head, hind-neck, mantle and lower parts green, with the neck-rings only faintly shadowed in verditer and black. There is less blue in the green of the scapulars, wing coverts and tertiaries and the pale edging to the wing-coverts is less defined. The central tail feathers are shorter and broader. Both sexes do, I believe, have orange and red beaks, not black as in the adult female.—H. W.]

The Blue-winged Paroquet is common in Travancore and Cochin, but confined exclusively to evergreen biotope. It is most abundant in the hills between about 1,500 and 3,500 ft. elevation, and Ferguson (*J.B.N.H.S.*, xv, 666) records it at 5,000 ft. in the High Range.

At Kūriārkūtti in the Annemalai Hills, small parties of 3 or 4 birds were not uncommon in the mixed bamboo and deciduous jungle on the verge of evergreen. In its accustomed habitat-type, however, it is usually, if not invariably, the only species of paroquet to be met with. It has a call of two harsh notes, somewhat like those of the Paradise Flycatcher (*Tchitrea*) but much louder. I frequently observed it feeding on the nectar of flowers of *Erythrina lithosperma* and *Grevillea robusta* shade trees in Coffee plantations in the usual destructive manner of paroquets.

Both Fairbank and Terry record it from the slopes of the Lower Palnis where it is apparently common. It does not occur in Ceylon.

Breeding: Specimen No. 406 (5 March) had a conspicuously granular ovary, though in plumage it is not fully adult. In No. 435 (10 March) the testes measured 6 × 4 mm. Both these birds as well as the third—with inactive ovary—were undergoing body and primaries moult (post-nuptial ?) and may have lately finished breeding. At this season, however, the birds were mostly observed in pairs, and some of them at any rate were undoubtedly breeding.

F. W. Bourdillon writes (*S.F.*, iv, 388) that this paroquet commences to lay in the first week of January, and fresh eggs (normally c/4) may be obtained in February. The site chosen is invariably a hole in a tree, usually the Iron-wood tree (*Mesua ferrea*) at a height of 16-100 ft. from the ground (T. F. Bourdillon, *J.B.N.H.S.*, xv, 666).

According to the *Fauna* (iv, 209) Bourdillon and Stewart found this species breeding in Travancore during January, February and March.

Coryllis vernalis rubropygius Stuart Baker. The Malabar Loriquet.

Specimens collected: 77 ♂ 13-1-33 Marāiyūr 3,500 ft.; 138 ♂ 24-1-33 Sānthanpāra 3,500 ft.; 205 ♂ 3-2-33 Thattakād 200 ft.; 743 ♀ 29-7-33 (Kūttāni ca. 300 ft.), 849 ♂ 13-8-33 (Nettayam ca. 200 ft.) Trivandrum Environs.

Elsewhere noted at: Kōttayam (ca. S.L.); Peermade (3,200 ft.); Kūmili (3,000 ft.); Camp Derāmalai (3,000 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Balamore Estate (2,000 ft.); Kodaiyār Lake Environs (South Travancore); along Cochin Forest Tramway, near Chālakūdi; Kūriārkūtti (1,600 ft.); Wadakkāncheri (400 ft.); from 1,500 ft. upwards along the ghat road from Nemmāra to Pādagiri 3,000 ft.—not below.

Colours of bare parts: Iris brownish-buff or greyish-khaki ('grey'—Pillai); bill reddish-orange; feet pale orange; claws horny brown.

[See my note on this form in the Eastern Ghats Survey (*J.B.N.H.S.*, xxxvii, 754).

The Survey specimens measure:

	Bill (from cere).	Wing.	Tail.
4 ♂♂	11-12	91.5-96	39.5-44 mm.
1 ♀	11.5	97.5	48 mm.

Additional specimens seen:

Brit. Mus. Coll.: ♂ 21-12-74, ♂♀ 16-12-78, Mynall (Bourdillon).—H. W.]

The Malabar Loriquet is a fairly common resident species in the Travancore-Cochin area, being found in well-wooded country from the neighbourhood of the backwaters, through the foothills, up to an elevation of 3,500-4,000 ft. and occasionally perhaps higher. It frequents secondary jungle, coffee and rubber plantations and the fruit gardens that commonly surround the homesteads along the backwaters. I believe it is to some extent locally migratory, its movements depending upon the flowering of certain trees and the ripening of the fruit of others—or, essentially, upon the availability of a food supply.

Its diet consists of Peepal and Banyan figs (*Ficus religiosa* and *F. bengalensis*) in addition to other fruits and berries both wild and cultivated. At certain seasons it lives largely or almost exclusively upon the nectar of flowers. It is also very fond of the exudation from the base of the petioles of the various Fici. *Erythrina lithosperma* shade trees in bloom in an abandoned rubber estate at Thattakād were observed to be literally swarming with these birds, who fed on the nectar all day long but more particularly in the morning and forenoon. Unlike the paroquets, they do not as a rule destroy the flowers in their efforts to get at the nectar, and consequently are of service in cross-pollinating them. A specimen shot off the blossoms had a quantity of pollen adhering to its chin and over a tablespoonful of nectar dripped from its bill when the bird was held up by a leg. It was noted that very few Loriquets resorted to the profusion of *Bombax malabaricum* flowers on a nearby tree although these were well-patronised by numerous other species. Their preference for *Erythrina* nectar is marked. The birds were also observed on occasion eating nectar from *Loranthus* (*loniceroides?*) buds. The technique in this case is to bite into the tubes near their bases, and thus they seem to be of no consequence in the fertilisation of the flowers of this parasite.

One of the specimens, when shot, clung to its perch head downward and was fluttering when a Tree Pie stooped on it from a neighbouring tree and seized it in a determined attempt to carry it off!

In the Palni Hills, Fairbank (*S.F.*, v, 395) observed this Loriquet at the eastern base and Terry (*S.F.*, x, 471) in the Pittur Valley.

The maximum wing measurement of 88 mm. given for this race in the *Fauna* (iv, 218) is surely a mistake. See measurements of the series supra.

In Ceylon it is replaced by *C. beryllinus*, a species of which Mr. Whistler believes (*J.B.N.H.S.*, xxxvii, 755) that *vernalis* may ultimately prove to be a race.

Breeding: The testes of No. 138 (24 January) measured 3 × 2 mm. and appeared to be developing. The gonads of the other specimens furnished no clue in this regard, and no other evidence was procured by the Surveys.

Bourdillon (*Nidification*, iii, 386) found a nest with c/3—hard set—on 15 March, and Stewart took another c/3 in Travancore on 6 January. The nest in the former case was at the top of a hollow stump over which a creeper was growing to form a sort of cover. It was about 15 ft. from the ground and at an elevation of 2,000 ft. (*J.B.N.H.S.*, xv, 666).

SUB-ORDER: CORACII.

FAMILY: CORACIIDÆ.

Coracias benghalensis indica Linn. The Southern Indian Roller.

Specimens collected: 474 ♀ 20-3-33 Rājampāra 1,350 ft.; 680 ♂ 16-7-33, 837 ♀ 12-8-33 Beach, Trivandrum; 937 ♀ 4-12-33 Nemmāra 300 ft.

Elsewhere noted at: Marāiyūr (3,500 ft.); Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Kūmili (3,000 ft.); Wadakkāncheri (400 ft.).

Colours of bare parts: Iris yellowish-brown or hazel brown; eyelids dusky orange yellow; bill brownish-black paler at gape and base of lower mandible; legs and feet dusky orange-yellow; claws black.

[Measurements:

	Bill.	Wing.	Tail.
1 ♂	49	180	moult.
3 ♀♀	43-43.5	171.5-181.5	109-124.5 mm.

The juvenile differs from the adult in the paler blue of the abdomen and the absence of any purple wash on the chin and throat. The tail-feathers are much narrower, the outer pair being much more rounded at the tips.

The post-nuptial moult is complete and there is apparently no pre-nuptial moult.—H. W.]

Concerning Travancore, Ferguson (*J.B.N.H.S.*, xv, 657) says: 'The Indian Roller is found in the low country . . . . It is not found in forest nor on the hills.' My own experience shows that while this statement is partly correct, it is by no means a wholly accurate description of the bird's status. The Surveys came across the Roller fairly commonly in the low country, but more sparingly and locally also at elevations up to 3,500 ft. in the hills. It frequents open cultivated country and 'toungya' clearings in deciduous or secondary mixed forest, usually in pairs. Elwes (*Ibis* 1870, p. 526) also met with it in the Cardamom Hills.

In the Palnis it appears to be sparingly distributed. Terry (*S.F.*, x, 471) observed it on one or two occasions in the Pittur Valley. Its occurrence in Ceylon is local.

Breeding: Specimen No. 937 (4 December) had a clearly granular ovary with the follicles apparently maturing. In that of No. 474 (20 March) some of the follicles measured over 1.5 mm. in diameter and it had a distended oviduct indicating that the bird had laid. From the beginning of March the noisy aerial displays of the male were much in evidence, and the birds were apparently breeding on the above date. The July-August specimens had finished breeding. Their gonads had reverted to normal quiescent condition and No. 680 was undergoing complete post-nuptial moult.

According to *Nidification* (iii, 390) Bourdillon took a c/4 in Travancore on 14 April.

Eurystomus orientalis (Linn.). The Broad-billed Roller.

Specimens collected: 236 ♂, 237 ♂ 7-2-33 Thattakād 200 ft.

Elsewhere noted at: Kūriārkūtti (at 2,000 ft.—Annemalai Hills).

Colours of bare parts: Iris brown; bill orange-red, tip blackish-brown; palate and gape pale sulphur yellow, gullet greyish-pink; legs and feet orange-red or coral-red; claws blackish-brown.

[Additional specimens seen:

Brit. Mus. Coll.: (♂? 21-12-72 Eridge (Bourdillon). Type of *laetior* Sharpe; ♂ 16-8-71 Ashāmbū Hills (Hume Coll.).

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
4 ♂♂	34.5-35.5	195.5-198	102-105	18.5-20.5 mm.—H. W.]

The Surveys came across the Broad-billed Roller exclusively in evergreen forest biotope in Travancore and Cochin. It is an uncommon species and not numerically abundant anywhere. At Thattakād it was partial to the neglected overgrown rubber plantations and clearings for *Bombax* and paddy cultivation in evergreen forest. The birds—usually single or pairs—were observed perching hunched up on the leafless topmost branches of some lofty tree towering above the forest, uttering a harsh *chack-chack* every second or two, alternated from time to time by a quicker repeated *chuck-chuck-chuck-chuck* in the same harsh tones. Occasionally they launched sallies after winged insects, performing curious evolutions in mid-air in the pursuit.

Bourdillon (*J.B.N.H.S.*, xv, 658) believed that the Broad-billed Roller was only a breeding visitor to Travancore. Confirmation is desirable, but it is not known precisely on what grounds his presumption is based, and in my opinion Mr. Whistler's doubt as to its correctness (*J.B.N.H.S.*, xxxvii, 756) is well justified.

Breeding: The gonads of the specimens were inactive and furnished no indication as regards breeding. Both the birds, however, appeared to be completing moult (pre-nuptial?) into fresh plumage.

F. W. Bourdillon took eggs on 17 April, and another clutch on 18 April. A full clutch is said to consist of 3 or 4 eggs, generally the latter. The brothers Bourdillon give the breeding season in Travancore as September to May (*Nidification*, iii, 392).

FAMILY: MEROPIDÆ.

Merops orientalis orientalis Latham. The Common Indian Bee-eater.

Specimens collected: 270 ♂ 11-2-33 Thattakād 200 ft.; 583 naked chick (in alcohol) 12-4-33 Cape Comorin ca. S.L.; 602 ♀ 16-4-33 Arāmboli 250 ft.; 677 ♀ imm. 16-7-33, 838 ♂ 12-8-33 (Beach), 729 ♀ 26-7-33, 824 ♂ 10-8-33 (Kūttāni ca. 300 ft.) Trivandrum Town and Environs; 898 ♀ 24-11-33 Wadakkāncheri 400 ft.; 952 ♀ 7-12-33 Nemmāra 300 ft.

Elsewhere noted at: Marāiyūr (3,500 ft.); Kōttayam and Vembanād Backwaters; Chālakūdi; Trichūr; Karūpadanna.

Colours of bare parts: *Adult*: Iris claret or crimson ('brownish-red' Pillai); bill brownish-black; mouth pink; legs and feet yellowish-brown; claws horny brown.

[Measurements:

	Bill.	Wing.	Tail.
3 ♂♂	30.5-32.5	93-95	112.5-117 mm.
5 ♀♀	30-32	92-93.5	84.5-104 mm.

The post-juvenal moult is complete. There is no spring moult and the post-nuptial moult is complete. Wear turns many of the green feathers blue, especially the tertiaries.

As a whole the Travancore series cannot be distinguished from the typical race, but a few specimens approximate to the richer colour of *M. o. birmanus*, as described in the Eastern Ghats Survey (*J.B.N.H.S.*, xxxvii, 756).—H. W.]

This small Bee-eater is a very common resident species in the low country of Travancore and Cochin. The Surveys did not come across it above an elevation of about 400 ft. except at Marāiyūr where, however, it was uncommon. Its altitudinal status in Travancore seems rather curious in view of the fact that in the Nilgiris it is said to ascend the hills up to 6,000 ft.

The birds frequent open sparsely scrubbed country, the outskirts of light secondary deciduous forest, and the neighbourhood of cultivated and fallow fields, by the backwaters as well as farther inland.

At Thattakād, in an open forest clearing for the Government *Bombax* plantation, this species was found in association with the Blue-tailed and the Chestnut-headed Bee-eaters.

Fairbank (*S.F.*, v, 394) found it common at the base of the Palni Hills and in the adjacent plains, and Terry (*S.F.*, x, 470) saw several in the Pittur Valley [elevation?].

The same, typical, race is common in the drier parts of Ceylon.

Breeding: On 1 January (1934—Karūpadanna) a pair were observed in copula on a telegraph wire at about 7 o'clock in the morning. The ♀ crouched and shivered in invitation to the ♂. Specimen No. 270 (11 February) had testes enlarged to 5 × 3 mm. and was evidently getting ready to breed. On 12 April (Cape Comorin) a nest tunnel, ca. 3 ft. long, was dug out in the side of a laterite and moorum borrow-pit. It contained two chicks just hatched out and 4 very hard-set eggs on the point of hatching. The latter measured: 19 × 17, 19 × 18, 20 × 17, 20 × 18 mm. respectively. Remains of hymenopterous insects were discovered within the tunnel. The specimen of 16 July was immature with an imperfectly ossified skull, the 3 other July-August specimens being adult with gonads reverted to non-breeding condition, and all in heavy post-nuptial moult.

From the data procured it is evident that, as in many other Travancore birds, the breeding season of the Bee-eater commences considerably earlier in this area than has been recorded elsewhere in its range.

Merops superciliosus javanicus Horsfield. The Blue-tailed Bee-eater.

Specimens collected: 226 ♀ 6-2-33 Thattakād 200 ft.; 902 o? 25-11-33 Wadakkāncheri 400 ft.; 1043 ♀, 1044 ♂ 30-12-33 Karūpadanna ca. S.L.

Elsewhere noted at: Kōttayam and Vembanād Backwaters; Chālakūdi.

Colours of bare parts: Iris claret coloured or crimson; bill horny-black; mouth pale pink; legs and feet pinkish-brown; claws blackish-brown.

[Measurements:

	Bill.	Wing.	Tail.
1 ♂	48	135	141 mm.
2 ♀♀	44.5-46	129-129.5	135-136 mm.

There is apparently no spring moult and the post-nuptial moult is complete. The post-juvenal moult appears to be complete but a good deal delayed.—H. W.]

The Blue-tailed Bee-eater is an uncommon, patchily and sparsely distributed species in the Travancore-Cochin low country. We have no information concerning its status here, but as in many other parts of its range, it may possibly be locally migratory. The Surveys recorded it only between 10 November and 17 February. Ferguson (*J.B.N.H.S.*, xv, 658) mentions that the only specimen in the Trivandrum Museum in his day was one shot near Trivandrum in August 1893. Kinloch (*J.B.N.H.S.*, xxvii, 942) describes it as very common on the northern slopes of the Nelliampathy Hills, but to what elevation or at what season he does not say. The Cochin Survey failed to come across this Bee-eater on the northern slopes of these hills, from Nemmāra at the base up to Pādagiri (3,000 ft.), between 3 and 21 December (1933) although the Chestnut-headed species was noted on the lower slopes.

It frequents more or less the same type of terrain as the Common Bee-eater, but seems to prefer slightly better wooded facies, and usually the neighbourhood of water. Along the Vembanād Backwaters it was noted as commoner and more abundant than the foregoing species. In the forest clearing for the Government *Bombax* plantation at Thattakād, these Bee-eaters were observed in association with *M. orientalis* and *M. leschenaulti*. A small flock was also seen bathing in a still pool in the Periyār River by taking flying dips into the water, after which the birds settled on trees on the bank, shuffled their plumage and dried themselves.

The stomachs of Nos. 1043 and 1044 were crammed full of Blue-bottle flies *Musca* (*vomitoria*?) which were swarming about the 'Kopra' being sun-dried everywhere along the backwaters.

In the Palni Hills, Fairbank (*S.F.*, v, 394) found this Bee-eater abundant by the town of Palni, near the north base of the hills, in October 1866, but on a subsequent visit [month ?] he saw it only once at Periūr. It is a winter visitor to Ceylon.

Breeding: The ovary of No. 226 (6 February) was slightly granular, but the gonads of the other specimen were inactive and no other data in this regard was obtained.

There is no published record of its breeding in Travancore or Cochin.

Merops leschenaulti leschenaulti Vieillot. The Chestnut-headed Bee-eater.

Specimens collected: 209 ♀ 3-2-33 Thattakād 200 ft.; 738 ♀ 29-7-33 Kūttāni 300 ft., Trivandrum Environs; 965 ♀ 10-12-33 Nemmāra 300 ft.

Elsewhere noted at: Sānthanpāra (3,500 ft.); Kūmili and Periyār Lake Environs (3,000 ft.); Camp Derāmalai (3,000 ft.); Kūriārkūtti (1,600 ft.); in forest along Cochin Forest Tramway, from Parambikolam to Chālakūdi.

Colours of bare parts: Iris crimson; bill horny black; mouth greyish-pink; legs, feet and claws blackish-brown.

[Measurements:

	Bill.	Wing.	Tail.
3 ♀♀	35-39	104.5-107	77.5-80 mm.

The post-nuptial moult is complete, and there is apparently no spring moult.—H. W.]

The Chestnut-headed Bee-eater is restricted to forested country in the hills as well as lower down. The Surveys came across it from 200 up to 3,500 ft. elevation. Ferguson (*J.B.N.H.S.*, xv, 558) found it not uncommon about Peermade and in the High Range in North Travancore, but wrongly considered it as confined to the hills only. It is, however, true that on the forested hills this species occurs to the exclusion of the two foregoing.

The birds were observed in pairs, small parties or fairly large flocks, perched on bare branches of tall trees at the edge of forest whence they launched aerial sallies after winged insects. At Sānthanpāra (27 January) a flock of over 30 birds was observed roosting in a tree in open jungle at sunset. Much noise and flying around in a rabble prevailed before darkness set in and the birds finally retired.

In the Palni Hills, Fairbank (*S.F.*, v, 394) found the Chestnut-headed Bee-eater plentiful on the eastern side of the hills at between 2,000 and 3,000 ft. in 1866, but in a subsequent year [months?] only saw it once. Terry (*S.F.*, x, 470) met with several birds in the Pittur Valley.

It is a local resident in Ceylon.

Breeding: The ovary of No. 209 (3 February) was conspicuously granular and showed signs of maturing. No other data was procured except that the specimen of 29 July was undergoing complete post-nuptial moult and had probably lately finished breeding.

According to Ferguson, the breeding season in Travancore is in February.

Alcemerops athertoni (Jardine and Selby). The Blue-bearded Bee-eater.

Specimen collected: 75 ♀ 12-1-33 Marāiyūr 3,500 ft.

Elsewhere not noted.

Colours of bare parts: Iris bright golden orange; bill horny brown, grey at chin and on basal half of lower mandible; mouth greyish-pink; legs and feet pale yellowish sage-green; claws horny brown.

[Measurements:

Bill.	Wing.	Tail.	Tarsus.
49	136	128.5	16 mm.

Here again I think there is no spring moult and a complete post-nuptial moult.—H. W.]

The Blue-bearded Bee-eater is evidently a rare species in Travancore. Ferguson (*J.B.N.H.S.*, xv, 658) never met with it himself, but included it in his list on the strength of some skins labelled 'Travancore' in the Trivandrum Museum. There is no record of its occurrence in Cochin.

The Survey came across this large bee-eater only at Marāiyūr, where pairs were observed on two or three occasions in the vicinity of dense secondary evergreen growth bordering the nullahs through the terraced paddy-fields. The birds were very shy.

Its harsh guttural *Kūr-r*, *kūr-r-r* notes closely resemble those of the Ceylon Green Barbet before it commences its *kutroo-kutroo* calls, but are somewhat deeper in tone. Its dipping flight likewise is very reminiscent of that bird's.

Fairbank (*S.F.*, v, 394) obtained this species at the head of the Kambam Valley which skirts the Palni Hills along their south-eastern base, in December 1866. He also observed a pair at Periūr on the Lower Palnis, in March.

It does not occur in Ceylon.

Breeding: The ovary of the specimen (12 January) showed but little departure from the non-breeding condition, but it presented a suggestively granular appearance. The bird—one of a pair—was shot from a tree overhanging the motor road. Immediately under this tree, in the side of a laterite cutting, was discovered a freshly excavated nest tunnel, for which I have no doubt this pair were responsible.

There is no published record of its breeding in Travancore. In Kanara, Davison took eggs in March (*Fauna*, iv, 243).

FAMILY: ALCEDINIDÆ.

Ceryle rudis travancoreensis Whistler. The Travancore Pied Kingfisher.

Specimens collected: 283 ♂ 15-2-33, 303 ♂ 18-2-33 Vembanād Lake, Kōttayam Backwaters.

Elsewhere noted at: Thattakād (200 ft.—on Periyār River); Chālakūdi; Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Arāmboli (250 ft.).

Colours of bare parts: Iris brown; bill brownish-black, paler at chin; mouth pink; legs, feet and claws brownish-black.

[Additional specimens seen:

Brit. Mus. Coll.: o? Travancore (Fry) Type; ♀ 16-11-78 Trivandrum (Bourdillon); 4 Anjango birds.

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
3 ♂♂	68-69	133.5-139	67-71	10.5 mm.
1 ♀	70	140	70.5	— mm.

Both the Survey specimens are undergoing a moult—which appears to be a complete post-nuptial moult—in February.—H. W.]

The Pied Kingfisher is a common resident species in both Travancore and Cochin. It is commonest on the backwaters where single birds or pairs may invariably be seen perched upon stakes and dykes, or hovering above the surface of the water and hurling themselves headlong on some unwary fish in their usual spectacular manner. They were also met with on tanks and rivers, but on the latter only where they were placid and smooth running with deep pools here and there. It was absent on the Periyār Lake (3,000 ft.) and appears to be confined to the low country and not to ascend the hills at all. It has not been noted in the Palni Hills. In Ceylon, the race *C. r. leucomelanura* Reichenb. replaces it.

Breeding: The testes of the specimens measured 6 × 4 and 7 × 5 mm. respectively. Both the birds were undergoing moult which Mr. Whistler considers to be a complete post-nuptial moult. This would indicate that the birds had lately finished breeding, although it must be mentioned that both of them were in pairs and no juvenile or sub-adult birds were observed in their company, or elsewhere on the backwaters, about this date. From the behaviour alone of these pairs, I certainly should have said that the birds were preparing to breed.

Alcedo atthis taprobana Kleinschmidt. The Common Ceylon Kingfisher.

Specimens collected: 281 ♂ 15-2-33 Vembanād Lake, Kōttayam Backwaters; 501 ♂ 27-3-33 Tenmalai 500 ft.; 944 o? imm. 5-12-33 Nemmāra 300 ft.

Elsewhere noted at: Thattakād (200 ft.); Kūmili (3,000 ft.); Camp Derāmalai (3,000 ft.); Chālakūdi; Shōranūr; Wadakkāncheri (400 ft.); Karūpadanna.

Colours of bare parts: *Adult*: Iris brown; bill brown with orange tinge, especially at gape; palate pale coral, gullet pink; legs and feet orange-coral; claws brown. *Immature*: Iris brown; upper mandible dark horny brown, lower mandible dusky orange, browner at tip; mouth pale orange; legs and feet deep dusky orange; claws horny brown.

[Measurements:

	Bill.	Wing.	Tail.	Tarsus.
2 ♂♂	44.5-45	71-73.5	29.5-32	8.5 mm.

Additional specimens seen:

Brit. Mus. Coll.: ♀ 16-11-75 Vellarny, Trivandrum (Bourdillon); ♀ 21-6-77 Vellarny Lake (Hume Coll.); ♂ 12-4-79 Kildonnan (?), Tvr. (Bourdillon); ♂ ?-1-73 Colachul (Bourdillon).—H. W.]

This little Kingfisher is common about the backwaters and by streams, tanks, roadside puddles, flooded paddy-fields and borrow-pits and the like, chiefly in the low country. It is usually seen singly, perched on some stake or stone or a branch overhanging water, jerkily bobbing its head up and down and wagging its apology of a tail in accompaniment. It darts swiftly over the surface of the water from one part of the stream or tank to another, uttering a sharp piping *chi-chee, chi-chee* etc. From time to time it will suddenly drop from its perch and disappear with a splash below the surface of the water presently to emerge with a small fish held crosswise in its bill. With this it will usually fly off at top speed to another perch at some distance where the prey is battered and bolted down head foremost.

Ferguson (*J.B.N.H.S.*, xv, 659) says that it does not ascend the hills, but the Surveys noted it not uncommonly in the environs of Periyār Lake at 3,000 ft. elevation. In the Nelliampathies, according to Kinloch (*J.B.N.H.S.*, xvii, 942) it is very rare, the few perennial streams of the plateau country being the only places where an occasional kingfisher may be seen.

All the information we have concerning it in the Palni Hills is that Terry (*S.F.*, x, 471) saw a pair near Goondar stream in the Pittur Valley. It is a common species in Ceylon.

Breeding: The testes of No. 501 (27 March) measured 3 × 2 mm. and appeared to be developing, while the bird was undergoing pre-nuptial (?) moult. No more precise evidence was procured by the Surveys. According to Ferguson, it breeds in Travancore during March.

Alcedo meninting subsp.? The Blue-eared Kingfisher.

Specimen collected: 196 ♀ 31-1-33 Sānthanpāra 3,500 ft.

Elsewhere not noted.

Colours of bare parts: Iris brown; bill upper mandible horny brown, lower mandible brownish-orange; gape and mouth orange-coral; legs, feet and claws orange-coral.

[The specimen measures:

Bill.	Wing.	Tail.	Tarsus.
45	72.5	27.5	8.5 mm.

I have seen no additional specimens since my note in the Eastern Ghats Survey (*J.B.N.H.S.*, xxxvii, 761) was written so can add nothing to what was written there.—H. W.]

Ferguson (*J.B.N.H.S.*, xv, 659) writes that in Travancore this kingfisher ('*beavani*') is found only in the neighbourhood of the streams at the foot of the hills where it is not uncommon. F. W. Bourdillon (*S.F.*, iv, 383) describes it as occurring, though less abundantly than *Halcyon smyrnensis*, in the same situations as the latter namely among the small patches of paddy cultivation on the banks of the larger streams at the foot of the hills.

Personally I consider this kingfisher rather rare in Travancore and I came across it only this once in the course of the Survey. It was not noted in Cochin. The specimen was a single bird in an Eeta (*Ochlandra travancorica*) thicket growing on the bank of and overhanging a shallow rocky stream through a cardamom shola and, be it noted, at an elevation of 3,500 ft. in the Cardamom Hills.

It is apparently rare in Ceylon also.

Breeding: The ovary of the specimen was inactive. *Nidification* (iii, 409) records that J. Stewart took a clutch of 6 eggs in South Travancore on 17 January.

[**Ceyx erithaca** (Linn.). The Three-toed Kingfisher.

Not met with by the Surveys in Travancore or Cochin, neither recorded thence by Ferguson, Bourdillon or Kinloch. On what authority Travancore has been included in its distribution in the *Fauna* (iv, 261) is not known.]

Ramphalcyon capensis [gurial (Pearson)]. The Brown-headed Stork-billed Kingfisher.

Specimens not procured.

Noted at: Sānthanpāra (3,500 ft.); Thattakād (200 ft.—on Periyār and Kandampāra Rivers); Kūmili (3,000 ft.); Tenmalai (500 ft.); Kūriārkūtti (1,600 ft.—Parambikolam River); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Ernākulam and Karūpadanna (Cochin Backwaters).

This large kingfisher is not uncommon on shady forest streams in both the States and was also met with on irrigation tanks and their channels where thickly lined with *Pandanus*, in well-wooded country about cultivation, and in similar facies by the backwaters. It is a generally distributed species, but nowhere abundant. I cannot confirm Ferguson's statement (*J.B.N.H.S.*, xv, 659) that it is confined to the low country, although perhaps it is commoner in the foothills and to an elevation of about 1,500 ft. Except when coursing up and down a forest stream from one pool to another, this kingfisher is oftener heard than seen. It has a habit of perching on a well-foliaged branch or thicket near or overhanging water and uttering its loud raucous cackling laugh. Single birds were usually seen, but occasionally also widely separated pairs.

Fairbank (*S.F.*, v, 394) noted it at the eastern base of the Palni Hills. It is said to occur in Ceylon 'throughout the wetter portions' (*Fauna*, iv, 265).

Breeding: Stewart and Bourdillon took eggs in Travancore in February and March, and the latter also obtained a c/4 on 20 July (*Nidification*, iii, 416).

Halcyon smyrnensis fusca (Boddaert). The Indian White-breasted Kingfisher.

Specimens collected: 71 ♀ 12-1-33 Maraiyūr 3,000 ft.; 698 ♂ 21-7-33 (Beach), 777 ♀ 3-8-33 (Kōvalam ca. 70 ft.), 860 ♂ 15-8-33 (Mārūthānkūzhi ca. 50 ft.) Trivandrum Environs; 997 (not sexed) 20-12-33 Pādagiri, Nelliampathy Hills 3,000 ft.

Elsewhere noted at: Mūnnār (5,000 ft.—High Range); Thattakād (200 ft.); Kōttayam (ca. S.L.); Peermade (3,200 ft.); Kūmili (3,000 ft.); Rājampāra (1,350 ft.), Cape Comorin; Arāmboli (250 ft.); Kodaiyār Lake Environs, South Travancore; Chālakūdi; Kūriārkūtti (1,600 ft.—Parambikolam River); Wadakkāncheri (400 ft.); Shōranūr; Nemmāra (300 ft.); Karūpadanna (ca. S.L.).

Colours of bare parts: Iris brown; bill brownish orange-red to bright deep coral; mouth orange-brick or coral; legs and feet dusky orange to coral red (brighter on hind tarsus and soles); claws blackish-brown.

[Additional specimen seen:

Brit. Mus. Coll.: ♀ 15-4-75 Mynall (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
2 ♂♂	58-63	116-117	76-76.5	13-15 mm.
3 ♀♀	58.5-64	120-121	75.5-86.5	14 mm.

There is no spring moult, and the post-nuptial moult is complete.—H. W.]

The White-breasted Kingfisher is the commonest and most widely distributed of the kingfishers in the States of Travancore and Cochin. It is found throughout the low country as well as up to at least 5,000 ft. elevation. Ferguson is again incorrect in precluding it from the hills.

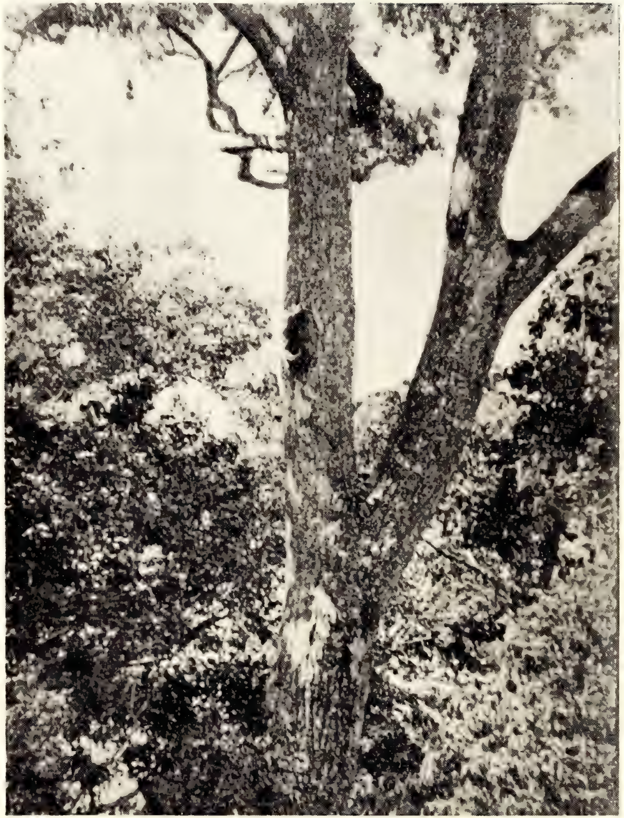
The bird is usually met with singly or in pairs in the neighbourhood of flooded paddy-fields and cultivation, ponds, puddles, kutcha wells and waterlogged borrow-pits, both near and away from human habitations. The trenches dug for irrigating the trees in cocoanut plantations along the backwaters, tenanted by frogs and water-beetles, provide favourite hunting grounds. It is, however, by no means so closely dependent upon water for sustenance as its other relatives are. Frequently it may indeed be found considerable distances away, in light deciduous jungle, where it feeds upon lizards, grasshoppers and other insects. It is perhaps the most catholic of all the Indian kingfishers in its diet, and will eat practically every living thing that can be come by or overpowered.

Fairbank (*S.F.*, v, 394) observed it at Periūr in the Lower Palnis and Terry (*S.F.*, x, 471) near the Goondar stream in the Pittur Valley. It is common in Ceylon.

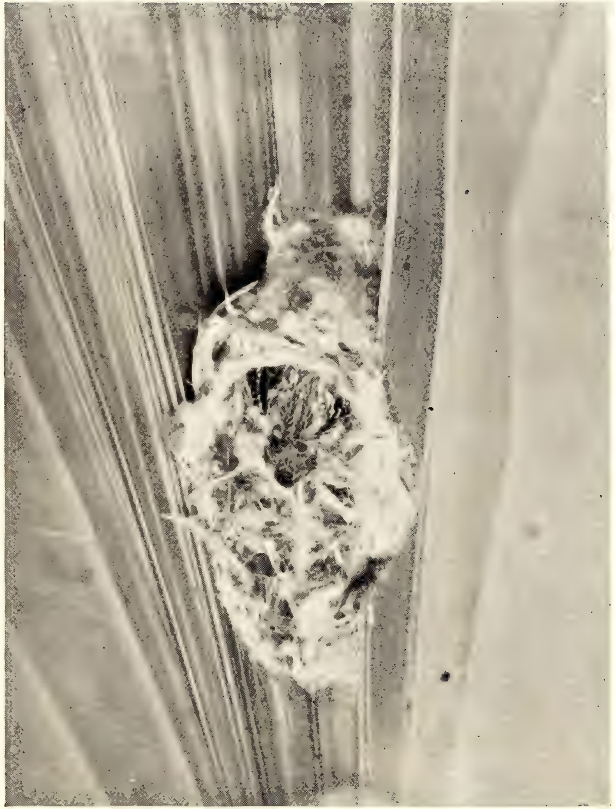
Breeding: By the middle of February some males had commenced to 'sing' from tree-tops in the morning. This 'singing' is distinct from the occasional and sporadic calling which may also be heard at other times of the year, and to my mind is definitely associated with the approach or progress of the breeding season. For one thing, it is much more regular in its incidence both as regards time and place, being uttered chiefly in the early mornings from some favourite branch near the top of a patricular tree or other exposed perch. The duration of this 'breeding song' is also considerably prolonged. The song itself may be described as a musical twittering scream or laugh, repeated sometimes for over a quarter of an hour. Each 'peal' ends in a detached undertone something like the *pench* of a snipe, audible only at close quarters and caused, I think, by the intake of fresh air after each call.

The gonads of the specimens were in a quiescent state. No other direct evidence as regards breeding was obtained by the Surveys. The specimen of 3 August, however, was undergoing a complete post-nuptial moult.

According to Ferguson (*J.B.N.H.S.*, xv, 659) and F. W. Bourdillon (*S.F.*, iv, 383) it breeds in Travancore in April.



Nest of the Great Indian Hornbill (*Dichoceros bicornis*)—
Periyār Lake, 4 March 1933.



Nest of Palm Swift (*Cypsiurus p. batassiensis*) in fold of
Palmyra leaf. Chick within—Cape Comorin, 8 April 1933.

Photos by *Sálim Ali.*

Halcyon pileata (Boddaert). The Black-capped Kingfisher.

Specimens not procured.

Noted at: Kūriārkūtti (1,600 ft.—on the Parambikolam River).

This is apparently an uncommon species. Ferguson (*J.B.N.H.S.*, xv, 659) refers to a specimen captured in a well at Trivandrum and brought alive to him, and I observed a single bird near some shallow rapids in the Parambikolam River on 17 November, but was unable to procure it.

It has not been recorded from the Palni Hills being more of a coastal species, but it occurs in Ceylon.

Breeding: *Nidification* (iii, 423) records that J. Stewart took a c/4 from a hole in the bank of a forest stream in Travancore. The precise locality and date are not mentioned.

[**Sauropatis chloris vidali** (Sharpe). The Malabar White-collared Kingfisher.

Not met with by the Surveys in Travancore or Cochin.

According to the *Fauna* (iv, 277) Stewart and Bourdillon both found it in Travancore and 'it appears to inhabit the coastal region from Travancore to Konkan'. However, as Mr. Whistler has pointed out (*J.B.N.H.S.*, xxxvii, 763), no specimens from anywhere south of Ratnagiri apparently exist and further evidence is necessary before the species can be admitted to the Travancore list.]

FAMILY: BUCEROTIDÆ.

Dichoceros bicornis (Linnaeus). The Great Indian Hornbill.

Specimens not procured.

Noted at: Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Kūmili and Periyār Lake Environs (3,000 ft.); Camp Derāmalai (3,000 ft.); Tenmalai (500 ft.); along Cochin Forest Tramway near Kūriārkūtti (ca. 1,000-1,500 ft.); Pādagiri (3,000 ft.—Nelliampathies).

The Great Indian Hornbill is common in the evergreen forest biotope of both Travancore and Cochin, where it was met with chiefly up to about 3,500 ft. elevation. Its deep harsh grunts and croaking, and the loud resonant calls *Tok, tok* etc. were heard reverberating in the forest-clad valleys and hillsides. These calls are responsible for its Malayāli name 'Malāmōrakki' meaning 'mountain-shaking'.

The birds were usually observed in pairs or parties of 3 to 5, but sometimes larger groups foregathered to feed on the ripe figs of the various *Fici*. In January, February and early March it was not unusual to find single males winging their way noisily high up in the air, presumably to and from the nests in quest of forage for their walled-in mates.

Both Fairbank and Terry record it in the Palni Hills, the former from the vicinity of the town of Palni, the latter in the Pittur (Putthur) Valley.

Curiously enough it does not occur in Ceylon, an anomaly which seems worthy of closer ecological investigation.

Breeding: The hillmen who were sent out to reconnoitre, discovered and took me to a nest on 4 March. It was in a hollow in the trunk of a lofty Poon tree (*Calophyllum tomentosum*)—about 50 ft. up—a short distance within primary evergreen forest along a secluded arm of the Periyār Lake. The diameter of the trunk at the nest site was 3½ to 4 ft., and through the narrow slit (about 8 × 2 in.) the hen could occasionally be observed by means of field-glasses, shifting her position (on the eggs ?) within. The plaster around the slit was extraordinarily well camouflaged and blended to perfection with the bark. One of the hillmen who had stayed behind to mark the place, informed me that the cock bird had visited the nest in the morning and fed the hen, but since then—and between 11 a.m. and 2 p.m. while I had it under observation—he remained absent. Finally he arrived with food at 3 o'clock. He was extremely wary and circumspect, alighting in the highest branches of a neighbouring tree and surveying his surroundings with the utmost caution. At 4 o'clock, when I had to leave the place, the bird was still hesitating to approach the nest, his suspicions having doubtless been enhanced by the removal of certain hanging creepers which obstructed the lens of my camera.

The information gathered from the hillmen is as follows: The male usually feeds his incarcerated mate three times a day, each feed occupying

15 to 20 minutes. In addition to these, he may pay short visits occasionally to the nest with a lizard or some similar tit-bit. The presence of a nest, even before the eggs have hatched, is usually betrayed by the droppings of the ♂ and fragments of the food he brings, lying on the ground or on bushes beneath the nest site. Whether the female also casts her excreta out through the slit I was unable to ascertain. The number of young are said to be two as a rule. After the young are hatched out, the hen issues forth from her self-imposed imprisonment, the pair visit the nest with food oftener and become very bold, noisy and demonstrative, attacking any person who ventures into the proximity of the nest-tree.

To this I may add that the hillmen esteem the hornbill squabs a great delicacy and seek them eagerly for food. What the true extent of such destruction is, and whether this persecution is having any effect upon the numbers or nesting habits of the bird, it would be interesting to investigate.

T. F. Bourdillon (*J.B.N.H.S.*, xv, 660) obtained an egg at the beginning of March in Travancore where according to *Nidification* (iii, 430) the breeding season is February, March and April.

Hydrocissa coronata (Boddaert). The Malabar Pied Hornbill.

Specimen not obtained.

The Travancore Survey only came across this species once—a flock of 7 birds in lofty tree-tops in heavy evergreen forest at the confluence of the Kandampāra stream with the Periyār River, about a mile below Thattakād.

Ferguson (*J.B.N.H.S.*, xv, 660) describes it as 'by no means common [in Travancore] but locally distributed in forest land at the foot of the hills'. He mentions a specimen in the Trivandrum Museum shot about 9 miles from Trivandrum. As against this, it may be noted that Kinloch (*J.B.N.H.S.*, xxvii, 942) found it 'very common' in the Nelliampathy Hills. The Cochin Survey, however, failed to meet with it in the locality around Pādagiri (3,000 ft.) in December.

Neither Fairbank nor Terry include the species in their Palnis lists. It occurs in Ceylon.

Breeding: *Nidification* (iii, 431) mentions that a single egg with young bird [hard-set?] was taken by Stewart in Travancore on 15 March.

Tockus griseus (Latham). The Malabar Grey Hornbill.

Specimens collected: 120 ♀, 121 ♀ 22-1-33 Sānthanpāra 3,500 ft.

Elsewhere noted at: Rājampāra (1,350 ft.); Tenmalai (500 ft.); Kuvallē Incline—Cochin Forest Tramway; Kūriārkūtti (1,600 ft.); Wadakkāncheri (400 ft.); Pādagiri (3,000 ft.).

Colours of bare parts: Iris brown in 120 (probably first year), reddish-brown in 121; bill in 120 brownish pale yellow, commissure, gape, a patch on each side of base of lower mandible and a triangular patch (ca. ¾ in.) on culmen near forehead brownish-slate; in 121 brownish-slate on culmen extending practically over entire culmen patchily and irregularly; mouth patchy pale yellow and brownish-slate; legs and feet greyish sage-green; claws black.

[Additional specimens examined:

Brit. Mus. Coll.: ♂ 18-2-14, ♀ 20-2-14 Aneichardi Estate (Stewart); ♀ 24-2-70 Cardamom Hills 3,000 ft. (Elwes); ♂ 15-4-75 Mynall (Bourdillon).

I take No. 120 to be a juvenile distinguished by the paler colouration, with a fulvous tinge about the vent. All the wing coverts are conspicuously edged with fulvous while the wing-quills are edged with pale grey except for the outer primaries which are conspicuously marked with white. The tail-feathers are narrower and the primaries more narrowly pointed than in the adult.—H. W.]

The Grey Hornbill is common in the evergreen forest tracts of Travancore and Cochin. I did not observe it below about 400 ft. elevation; it was most abundant in the Cardamom Hills between 3,000 and 3,500 ft. Ferguson (*J.B.N.H.S.*, xv, 660) states that he shot it at over 5,000 ft. on the High Range and at 4,000 ft. on Chimunji in South Travancore. Kinloch (*J.B.N.H.S.*, xxvii, 942) found it 'very common' in the Nelliampathy Hills, and this was also the experience of the Survey in the locality about Pādagiri, Its favourite haunts were the lofty shade trees in cardamom *sholas*, where flocks of 5 to 6 birds were usually met with amongst the tops of the various *Fici*, feeding on the figs or flying about from one tree to another in follow-my-leader fashion. In such places it was not uncommon to find larger congregations associating with grackles and a number of other frugivorous species. They are rowdy birds and keep up an incessant variety of loud harsh croaks, chuckles and mock laughter, varied now and then by raucous cackling. Several of their harsh screams are strongly reminiscent of the loud protestations of the domestic *murghi* when held up by its legs.

Fairbank (*S.F.*, v, 395) writes that he obtained a specimen of this hornbill at the eastern (dry) base of the Palni Hills in 1867, but did not observe another during five weeks' special search for it on the hillsides and in the groves in a subsequent year. Terry does not include it in his Palni list, all of which suggests that it is rare in those hills.

In Ceylon it is replaced by what must be considered another species rather than race of this, namely *Tockus gingalensis*.

Breeding: The ovarian follicles of No. 121 (22 January) were conspicuously granular, some measuring over 1 mm. in diameter, and the bird was probably approaching breeding condition. *Nidification* (iii, 441) gives the breeding season in Travancore as January to early April, but mentions that most eggs are found in February. According to Bourdillon 3 eggs form a normal clutch, but J. Stewart has apparently taken a good many c/4 around Aneichardi.

FAMILY: UPUPIDÆ.

Upupa epops ceylonensis Reichenbach. The Ceylon Hoopoe.

Specimens collected: 42 ♂ 9-1-33 Marāiyūr 3,500 ft.; 546 ♂ 9-4-33, 563 ♂ 11-4-33 Cape Comorin ca. S.L.; 992 ♂ 18-12-33 Pādagiri 3,000 ft.

Elsewhere noted at: Mūnnār (5,000 ft.); Devikolam; Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Peermade (3,200 ft.); Kūmili (3,000 ft.); Camp Derāmalai (3,000 ft.); Tenmalai (500 ft.); Trivandrum Town (ca. 50 ft.); Arāmboli (250 ft.); Ashāmbū Hills (at ca. 500 ft.); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Trichūr; Ernākulam.

Colours of bare parts: Iris dark brown; bill horny brown or horny black at tip gradually paling into greyish at base; mouth pink; legs and feet horny brown; claws brown.

[The 4 males measure:

Bill.	Wing.	Tail.	Tarsus.
56-62.5	133-136	92-99	21.5-22 mm.—H. W.]

The Hoopoe is a generally distributed species throughout Travancore and Cochin though nowhere abundant. The Surveys came across it sporadically, singly or in pairs, inhabiting the drier and opener parts of the low country as well as hills up to at least 5,000 ft. Ferguson (*J.B.N.H.S.*, xv, 660) writes: 'During the hot weather about March it may be found in the hills even ascending the High Range' which would make it out to be a seasonal altitudinal migrant. Kinloch (*J.B.N.H.S.*, xxvii, 942), however, does not refer to this peculiarity in the Nelliampathies, neither do the Survey dates convey that impression. Unfortunately we have no first-hand data for the hills during the South-West Monsoon season i.e. May to October.

In the low country single birds or scattered pairs were met with about cultivation, villages, in large compounds of the more populous towns and also in light deciduous jungle. In smaller numbers they were occasionally observed in evergreen forest tracts also, both hill and plain, but never actually within forest. In these localities they kept to the deciduous country on its fringe, to the *taungya* clearings or to paths and thinly shaded spaces in tea or coffee plantations.

Fairbank (*S.F.*, v, 399) observed this hoopoe on the Lower Palnis, but particularly mentions that he also shot one specimen belonging to the typical European race, *U. e. epops*, there.

It is a resident but locally distributed species in Ceylon.

Breeding: In specimen No. 992 (18 December) the testes measured 6 × 3 mm. It was one of a pair calling *hoo-po-po* etc. from exposed perches.

Specimen No. 42 (9 January) also appeared to be similarly preparing to breed. The gonads of the other two specimens were in a quiescent state. On 24 February (Peermade, 3,200 ft.) a bird was observed conveying food in its bill, but the nest was not located.

The *Fauna* (iv, 312) gives the breeding season for South India as February to April; for Ceylon November to April with possibly a second brood later.

SUB-ORDER: TROGONES.

FAMILY: TROGONIDÆ.

Harpactes fasciatus malabaricus (Gould). The Malabar Trogon.

Specimens collected: 8 ♂ 4-1-33 Marāiyūr 3,500 ft.; 214 ♂ 4-2-33, 224 o? 6-2-33 Thattakād 200 ft.; 492 ♂ 26-3-33 Tenmalai 500 ft.; 874 ♀ 16-11-33 Kūriārkūtti 1,600 ft.

Elsewhere noted at: Kūmili and Periyār Lake Environs (ca. 3,000 ft.); Rājampāra (1,350 ft.); Ashāmbū Hills (ca. 2,000 ft.).

Colours of bare parts: Iris dark brown (in ♀ 874 chestnut brown); bill blue, black on culmen and tips of both mandibles; mouth pink; orbital and suborbital skin bright cobalt blue; legs and feet paler blue ('dusky sky blue'); claws horny brown.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ 19-6-77 Shemiganur 5,000 ft.—Palnis (Fairbank); ♂ 4-12-72 Eridge (Bourdillon); ♀ 8-12-74 Mynall (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
5 ♂♂	21.5-23	122-128.5	160-179.5	13-15 mm.
1 ♀	20	127.5	166	14.5 mm.—H. W.]

As Ferguson describes it (*J.B.N.H.S.*, xv, 663), this beautiful trogon is not uncommon in the heavily forested tracts of Travancore and also of Cochin. The Surveys came across it both in the plains forests as well as up in the hills —between 200 and 3,500 ft. elevation. It is usually seen singly or in scattered pairs frequenting dense evergreen (or mixed) jungle and undergrowth, flitting about gracefully from branch to branch or tree to tree, or turning and twisting in the air after winged insects like *Tchitrea.* I frequently observed it clinging laterally on to the branches in quest of food. On the whole the birds were silent, but their curious low mewing calls occasionally helped to give their presence away. This trogon is rather crepuscular in its habits and may often be seen actively hawking beetles well after dusk. When perched on a branch, it somehow always contrives to keep the less conspicuously coloured back turned to the observer, which, coupled with its habit of sitting quite motionless, not infrequently helps it to evade observation! Specimen No. 874 emitted an unpleasant odour.

Kinloch (*J.B.N.H.S.*, xxvii, 942) who describes this trogon as common in the Nelliampathy Hills, notices a curious habit it has while perched, of expanding and elevating its tail and uttering a low twittering creak the while. He suggests that this is possibly a courting display.

From Fairbank's account (*S.F.*, v, 393) it would appear that the bird is rather uncommon in the Palni Hills. The typical race *H. f. fasciatus* replaces it in Ceylon.

Breeding: The gonads of the specimens were inactive and furnished no indication as regards breeding. Specimen No. 492 (26 March), however, was undergoing heavy post-nuptial (?) moult.

On 27 April (Ashāmbū Hills, ca. 2,500 ft.) Humayun Abdulali discovered a nest in a dense evergreen *shola* on a hillside, close to the edge. It was an untidy, flimsy platform of rotten twigs etc. slightly cupped in the centre, wedged in at a height of about 8 ft. between a growing sapling and a sweeping cane-stem. It was a disreputable and deserted looking structure, reminiscent of a dove's nest. The two eggs it contained—pale ivory white, unspotted —were well-glossed, and measured 27 × 22 and 27 × 21 mm. respectively. The female, when disturbed off the nest, dived into the undergrowth below with a series of *turr-rr* etc. The male sat watching on a huge tree about 20 yds. away.

The above case is interesting and would appear rather exceptional in view of the statement in *Nidification* (iii, 448) that 'For nesting purposes the birds select natural holes in dead trees or more often, in stumps of trees in the gloomiest parts of the forest. . . .'

The breeding season in Travancore is said (ibid) to be from February to May, Bourdillon and Stewart having taken eggs from 29 February to 12 May. The normal clutch is said to consist of 2 to 4 eggs.

SUB-ORDER: CYPSELI.

FAMILY: MICROPIDÆ.

Micropus melba bakeri (Hartert). The Indian Alpine Swift.

Specimen not obtained.

Noted at: Marāiyūr (near Kōdekkadu and Kaipānjimalai 5,000-6,500 ft.); Kōttayam (ca. S.L.); Mūthūkūzhi (Ashāmbu Hills, ca. 4,000 ft.); Pādagiri (at ca. 4,500 ft.—Nelliampathy Hills).

The Alpine Swift is evidently a resident species and not uncommon on the High Range and the other higher hills of Travancore and Cochin. Numbers were usually seen hawking insects over the grassy hilltops or above the intervening valleys. On one occasion a party of these swifts was observed by the Kōttayaṁ Backwaters near Kūmāragam, hawking insects high above the crowns of the cocoanut palms and frequently sweeping down to within a few feet of the water-logged paddy fields.

Ferguson (*J.B.N.H.S.*, xv, 661) shot these birds on the High Range and there saw them in numbers hawking insects through the smoke wherever the grass was being burnt.

In the Palni Hills, Terry (*S.F.*, x, 469-70) found a large number of Alpine Swifts on a cliff near Pittur (Putthūr) where he thought they were nesting. He could not ascertain this owing to the inaccessible nature of the place.

It occurs in Ceylon, but as far as I know has not definitely been found breeding on the island. However, W. W. A. Phillips [*Ceylon Jour. Sci.* (B), xviii, 252] describes what is evidently a breeding place at Rangala. It was inaccessible.

The reports and suggestions of its breeding on the cliffs and precipices about the Gairsoppa Falls on the Mysore-Kanara border have at last recently been confirmed by Humayun Abdulali who saw the birds building, and collected specimens with fully active gonads on 26 December 1935 (*J.B.N.H.S.*, xxxviii, 829-30).

No nesting in Travancore or Cochin has been noted, but in view of the above there seems no reason to doubt its doing so, since suitable cliffs and precipices are available in the Nelliampathies of Cochin and in the High Range and other mountains of Travancore.

Micropus affinis subsp.? The House-Swift.

Specimens collected: 596 ♂ 15-4-33, 619 ♂ 18-4-33 Arāmboli 250 ft.

Elsewhere noted at: Kōttayam (ca. S.L.); Karūpadanna (ca. S.L.).

Colours of bare parts: 'Iris brown; bill black; mouth fleshy; legs and feet fleshy shading into black; claws black' (Humayun and Pillai).

[See my remarks under Eastern Ghats Survey (*J.B.N.H.S.*, xxxviii, 30-32) which explain why these birds cannot be subspecifically named.—H. W.]

On the whole, the House Swift is an uncommon, patchily and capriciously distributed species in the Travancore-Cochin area. It is evidently confined to the low country and does not seem to ascend the hills at all. The Surveys only have the following records:

1. A pair about the Travellers' Bungalow at Kōttayam (February).
2. A nesting colony of about 50 birds in the Arāmboli Gap (April).
3. Two pairs about the Travellers' Bungalow at Karūpadanna (December).

In the last case the birds occasionally visited the remains (or foundation ?) of a nest in the rafters of the verandah. In the evenings it was their habit to disport themselves, flying in close formation in and out of the verandah and twittering loudly. The flight on these occasions consisted of a butterfly-like fluttering—wings raised well above the back and only their tips vibrating rapidly.

Ferguson's collectors found a colony breeding in January 1903 in the Registrar's office in North Parur in North Travancore, but he himself never came across this swift in the State (*J.B.N.H.S.*, xv, 661). In the Palni Hills, Terry (*S.F.*, x, 470) found it not uncommon at Pittur and Kukal, but saw it nowhere else. Fairbank (*S.F.*, v, 393) observed a dozen or so hawking insects above the tree-tops at 3,000 ft. elevation. [This or *Indicapus*?]

It occurs in Ceylon, but the birds from the island are darker.

Breeding: Specimen No. 596 (15 April) had its testes enlarged to 6 × 4 mm. It was in general body moult (post-nuptial?) and exceedingly fat. In No. 619 (18 April) the gonads were in a quiescent state. Attached to the ceiling of the projecting section of an enormous boulder hillock on the southern side of the Arāmboli Gap was a colony of about 18 nests, apparently all occupied. Owing to the inaccessibility of the situation their contents could not be ascertained. The birds constantly flew to and from the nests in a body with a great deal of twittering, and kept wheeling round and hawking insects in the neighbourhood.

The breeding months in Malabar and Travancore are said to be the same as in Ceylon, viz., February and March (*Fauna*, iv, 334).

Cypsiurus parvus batassiensis (Griffith). The Bengal Palm Swift.

Specimens collected: 531 nestling, 532 o? ad. 8-4-33, 589 ♂ 13-4-33 Cape Comorin ca. S.L.; 950 o? 6-12-33 Nemmāra 300 ft.

Elsewhere noted at: Kōttayam (ca. S.L.); Trivandrum (ca. S.L.); Wadakkāncheri (400 ft.); Pālghāt Gap; Karūpadanna (ca. S.L.).

Colours of bare parts: *Nestling* (531): Iris brown; bill, legs, feet and claws pinkish-brown. *Adult*: Iris brown; bill dark horny brown; mouth pinkish-grey; legs, feet and claws pinkish-brown.

[Additional specimen seen:

Brit. Mus. Coll.: ♂ 28-2-75 Kolachul (Hume Coll.).

Measurements:

	Bill.	Wing.	Central tail.	Outer tail.
1 ♂	7.5	113	31	65.5 mm.—H. W.]

As elsewhere, the Palm Swift is common in the low and dry country of Travancore and Cochin wherever the Palmyra Palm (*Borassus flabellifer*) occurs. It seems to be definitely symbiotic with it, but what the precise factors are that control this symbiosis have still to be determined.

In the Palni Hills also, Fairbank (*S.F.*, v, 393) observed it about Palmyra trees in Periākulam near the eastern base (dry country). It is common in the plains and low hills of Ceylon in suitable facies.

Breeding: On 8 April (Cape Comorin) a nest was located in a fold or furrow of a Palmyra leaf, about 30 ft. up. The leaf was cut off at the stem and lowered for examination by means of a rope. The nest (see photo) was a tiny saucer of agglutinated feathers, and down and seeds of the *Ak* plant (*Calotropis*). The attachment to the leaf along the rim of the saucer was 110 mm. long, the other measurements being as follows: Width of saucer from side to side 38 mm.; width, back to front 28 mm.; the actual saucer or egg chamber was 10 mm. deep from the rim. The fabric at the bottom was 10 mm. thick; the thickness of the top edge of the rim in front, 1 mm. The nest contained a single chick, naked except for the sprouting feather-tracts and quills. Throughout the rough handling that the leaf received in the hacking and lowering process, when it swayed violently in the breeze, the chick held on tenaciously to the fibrous lining of the nest. This capacity for retaining its hold under turbulent conditions must undoubtedly be of high survival value to the chick during storms.

In the same furrow of the leaf as held the nest, and about 8 in. above it, hung a pipistrelle bat, apparently both the occupants living on amicable terms. The swift and the bat may be considered as filling identical ecological 'niches', but the former is diurnal while the latter does the night shift. A detailed ecological study of a Palmyra palm would no doubt yield interesting results.

Specimen No. 532 shot near the nest tree, and presumably one of the parents, was very fat. It had an incubation patch and was moulting its secondaries; its gonads had evidently reverted to normal size, but shot damage made sexing impossible. Its gular pouch was crammed full of flying ants and other tiny hymenopterous insects. No. 589, with testes ca. 3 × 2 mm., had evidently finished breeding. It was undergoing complete post-nuptial moult. In No. 950 (6 December) the gonads were not discernible. It was in freshly moulted plumage (post-juvenal ?).

Apparently no published records of its breeding in Travancore or Cochin exist, but in Ceylon October to April is said to be the season (*Fauna*, iv, 337).

SUB-FAMILY: CHÆTURINÆ.

Chætura giganteus indicus (Hume). The Brown-throated Spinetail.

Specimens collected: 347 ♂, 348 ♀ 24-2-33 Peermade 3,200 ft.

Elsewhere noted at: Thattakād (200 ft.); Camp Derāmalai (Ūppūkūlam 3,000-4,000 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Balamore Estate and Ashāmbū Hills (500-3,500 ft.); Kodaiyār Lake Environs; Kūriārkūtti (at 3,500 ft.—Annemalai Hills); Pādagiri (3,000-4,000 ft.—Nelliampathy Hills).

Colours of bare parts: Iris brown; bill horny-black; mouth greyish-pink; legs and feet greyish-pink; claws horny brown.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ 14-10-76, ♂ 3-11-78, ♂ 5-1-80 Mynall (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
4 ♂♂	13.5-16	190-200	56-59	16.5-17.5 mm.
1 ♀	13	195	60	18.5 mm.—H. W.]

This magnificent swift is fairly common and evidently a resident in the hills of Travancore and Cochin. Kinloch's statement (*J.B.N.H.S.*, xxvii, 942) suggests that in the Nelliampathy Hills it is only a cold weather visitor. The Survey also came across it in the low and foothills country at Thattakād in the neighbourhood of fairly heavy deciduous jungle. The range of elevation recorded for it in my notes is 200-4,000 ft. above sea level. Hilltops, both grass-covered and with forest interspersed, are favourite hunting grounds, and in the mornings and evenings numbers of these birds were commonly to be seen swishing through the air majestically over these at tremendous speed, hawking insects and disporting themselves. The ease, grace and swiftness with which they follow the contours of the hilltops or sweep around overhangs is exhilarating to watch.

Bourdillon has an interesting note on this swift in *Stray Feathers*, vii, 34. He says that a flight during the early showers of April is a pretty sure indication of the approach of a storm. What exactly he means by 'flight', however, is not clear. Possibly he refers to the 'balling' as of the Common House Swift.

This species has not been recorded from the Palni Hills either by Fairbank or Terry. In Ceylon, it is resident on the hills.

Breeding: Both the specimens (24 February) were evidently breeding. They were freshly moulted. The testes of the male measured 18 × 5 mm., while the female had a soft ovarian egg and her oviduct was considerably distended. Unfortunately the nest site was not discovered, but there was a deserted factory chimney on a grassy hilltop in the neighbourhood which the birds were observed flying in and out of, and at the bottom of which I suspect they may have been nesting. T. F. Bourdillon (*J.B.N.H.S.*, xv, 661) observed a bird flying with a straw in its bill at the beginning of April, but was doubtful of this species breeding in Travancore.

It was not until 1913 that Mr. J. Stewart—to whom we are indebted for so much recent information on Travancore birds—found this swift roosting and breeding in large hollow green trees (chiefly *Vateria indica*) in the Travancore hills. His note on the subject (*J.B.N.H.S.*, xxii, 393) is so interesting that I quote it *in extenso*. He writes: 'I have on several occasions seen colonies of 30-50 birds roosting in trees, but have only just succeeded in finding them breeding. On the 12th instant [March 1913] I discovered a tree in which the birds were popping out and in at the only entrance which was at a height of about 45 ft.; the tree was hollow from top to bottom, and, on cutting a hole in it near the ground I found two nests each containing 2 fresh eggs. The nests were mere depressions in the earth at the foot of the tree with dry leaves and straw. The eggs were pure porcelain white with very hard shells, the average size of the 4 eggs is 1.28 × 1 in. I have since tapped another tree in the same way and found 3 nests at the foot of it; 2 nests were empty and the third contained 2 young birds. All the trees I have seen occupied by this swift have been at elevations of 1,000-2,000 ft. in heavy forest'. Subsequently Mr. Stewart obtained a considerable number of their eggs. Although the birds roost in the hollow trunks, at times in large colonies, he never found more than two pairs breeding in one tree, and usually only a single pair. Three or four eggs form the normal clutch according to him, but he has found as many as 5 eggs in a nest. *Nidification* (iii, 466) adds that the breeding season in Travancore is March and April.

Indicapus sylvaticus (Blyth). The White-rumped Spinetail.

Specimens collected: 228 ♂, 229 ♀ 6-2-33 Thattakād 200 ft.

Elsewhere noted at: Peermade (3,200 ft.); Kūriārkūtti (1,600-2,500 ft.).

Colours of bare parts: Iris brown; bill blackish-brown; mouth greyish-pink; legs and feet pinkish-brown; claws blackish-brown.

[Measurements:

	Bill.	Wing.	Tail.
1 ♂	8	114	37 mm.
1 ♀	7	115	36 mm.—H. W.]

A loose flock of about 20 of these little Spinetails was first observed by the Travancore Survey hawking insects on the right bank of the Periyār River at Thattakād, and above the forest clearing for the government *Bombax* plantation. Subsequently (24 February) twos and threes were seen flying over grassy hills at Peermade. On the evening of 16 November a flock of 15 or more birds were observed disporting themselves in the air on the Parambikolam River at Kūriārkūtti (Cochin) flying over the surface and wheeling round in orderly fashion. The birds utter a twittering *chick-chick* in flight like the Common Swift and their appearance on the wing is also greatly reminiscent of that bird. The above constitute the only records obtained by the Surveys. They indicate that the species is not common in this area, and also somewhat patchily distributed. Ferguson and Bourdillon do not appear to have come across it in Travancore.

There is no record of its occurrence in the Palni Hills. It is not found in Ceylon.

Breeding: The gonads of the specimens (6 February) showed signs of maturing. Both of them, moreover, were in freshly moulted plumage and evidently ready to breed shortly. The testes of the male measured 4 × 3 mm.; the ovarian follicles of the female were .5-1 mm. in diameter.

According to J. Stewart (*J.B.N.H.S.*, xxii, 394) these spinetails breed in the Travancore hills in open forest at elevations of about 2,000 ft., but not in colonies. The nest is made of vegetable fibre strongly attached with saliva to the inside of a hollow tree. *Nidification* (iii, 467) adds that according to the same observer the breeding season in Travancore is March and April, but that a few eggs may be found in the first half of May. The normal clutch is said to be of 3 to 5 eggs.

Collocalia fuciphaga unicolor (Jerdon). The Indian Edible Swiftlet.

Specimen not obtained.

Noted (unconfirmed) only at Tenmalai (500 ft.) on 27 March. Several birds (50-60) hawking insects high above a Teak plantation.

[Travancore specimens seen:

Brit. Mus. Coll.: ♂♂ 18-3-75 Eridge (Bourdillon).

Measurements:

	Bill.	Wing.	Central tail.	Outer tail.
2 ♂♂	8-8.5	115-117	41-44.5	53.5-54 mm.—H. W.]

Ferguson (*J.B.N.H.S.*, xv, 662) describes this swiftlet as 'Common in the hills [of Travancore] where it is resident' and Bourdillon (*S.F.*, iv, 374) likewise says 'Resident on the hills and very abundant'. In view of these statements it is curious that the Surveys did not come across it more than in the one doubtful instance given. It is indeed surprising that they should have so consistently evaded observation during the seven months spent in famous Pillar Rocks. It is a generally distributed resident in Ceylon.

In the Palni Hills also this swiftlet is apparently common. In about 1886, Terry (*S.F.*, x, 470) saw large numbers flying about over the lake at Kodaikānal. R. Foulkes (*J.B.N.H.S.*, xv, 727) found the same in 1904 and describes how one bird splashed into the water and would have drowned but for his rescue. According to both these observers, it appears that they breed regularly in the Palni Hills, a favourite site being the caves and sides of the famous Pillar Rocks.

Breeding: Bourdillon (*S.F.*, iv, 374-6 and *J.B.N.H.S.*, xv, 662) gives very good accounts of the nesting of this swiftlet in Travancore. According to him, it breeds abundantly throughout the hills, sometimes in small colonies of 4 or 5 pairs, and sometimes in larger colonies of as many hundreds. The largest breeding place he knew of was a cave situated at the base of a grass ridge in South Travancore at about 2,300 ft. elevation. In this he found from two to three hundred nests in March, the greater number containing 2 eggs each. This number in a clutch is said to be almost invariable.

Nidification (iii, 469) gives the breeding season in Travancore as April, May and June.

SUB-FAMILY: HEMIPROCNINÆ.

Hemiprocne coronata (Tickell). The Indian Crested Swift.

Specimens collected: 217 ♀ 4-2-33 Thattakād 200 ft.; 387 ♂ 1-3-33 Kūmili 3,000 ft.; 825 ♀, 826 ♀, 827 ♂, 828 ♂, 829 ♀ 10-8-33 Kūttyāni 300 ft.—Trivandrum Environs; 903 ♂ 25-11-33 Wadakkāncheri 400 ft.

Elsewhere noted at: Marāiyūr (Kōdekkadu and Kaipānjimalai ca. 5,000 ft.); Nemmāra (300 ft.).

Colours of bare parts: Iris brown; bill horny black; mouth greyish-pink; legs and feet pinkish-brown ('slaty-grey'—Pillai); claws blackish-brown.

[Measurements:

	Bill.	Wing.	Central tail.	Outer tail.
4 ♂♂	11-12.5	150-151	40-45	122-129 mm.
4 ♀♀	12-13	148-159	41-46	125 mm.

The very distinct juvenile plumage of this swift is well known. The postjuvenal moult apparently does not include the primaries and the coverts, the secondaries and greater coverts, the tertiaries and the tail. Except for these unmoulted parts, the first winter male agrees with the adult male. There is a complete autumn moult in which the body plumage is usually changed well before the wings and tail. There appears to be a partial body moult in the spring.—H. W.]

The Crested Swift is not uncommon in Travancore and Cochin. It is evidently a resident species though in the Nelliampathies, Kinloch (*J.B.N.H.S.*, xxvii, 942) seems to have found it in the cold weather only. It is closely confined to deciduous forest country, and therefore met with especially about the foothills. The birds are partial to *taungya* clearings in this biotope where they may usually be seen hawking insects above the clearing or crops, or perched on the bare topmost branches of trees bordering them. Open, lightly wooded grass jungle also forms a favourite haunt.

It has a variety of loud, rather harsh but not unpleasant notes which are mostly uttered from a perch, but occasionally also on the wing. The commonest of these may be rendered as *whit-uck, whit-uck, whit-uck* etc. while others are best likened to the 'scolding' notes of the Shikra (*Astur badius*).

In the Palni Hills, Fairbank (*S.F.*, v, 393) obtained only a single juvenile at the eastern (dry, deciduous) base, but Terry (*S.F.*, x, 470) records it as pretty common on the slopes and at Pulungi (Pallangi). On 7 April he found a nest in the Pittur (Putthūr) Valley containing one hard-set egg.

The Crested Swift is resident and generally distributed in Ceylon.

Breeding: The testes of specimen No. 903 (25 November) were enlarged to 5 × 3 mm. and appeared to be maturing. An incubation patch was present although the bird was apparently not breeding as yet. No. 217 (4 February) possessed a fully mature ovary containing a soft egg 13 mm. in diameter. Its oviduct was much distended, however, suggesting that the single egg the bird usually lays had already been deposited. No. 387 (1 March), with testes 5 × 3 mm. and a conspicuous incubation patch, had probably lately finished breeding as it was in post-nuptial body moult. All the August specimens were also undergoing general post-nuptial body moult.

There is no published record of the breeding of the Crested Swift in Travancore or Cochin. The data obtained by the Surveys suggests the season as November-December to February-March, therefore earlier than in most parts of its other Indian range and corresponding rather with Ceylon where it is said (*Fauna*, iv, 355) to lay in February and March.

SUB-ORDER: CAPRIMULGI.

FAMILY: CAPRIMULGIDÆ.

Caprimulgus macrourus atripennis Jerdon. Jerdon's Long-tailed Nightjar.

Specimen collected: 76 ♀ 12-1-33 Marāiyūr 3,500 ft.

Elsewhere not satisfactorily differentiated.

Colours of bare parts: Iris brown; bill horny brown, yellowish on commissure and gape; feet pinkish-brown; claws pale horny brown.

[Additional specimen seen:

Trivandrum Mus. Coll.: ♂ 30-8-03 Koni, Travancore.—H. W.]

The specimen was shot at dusk in a roadside field. Several others were observed at the same time squatting at intervals along the High Range motor road in this locality, flying up and into the fallow fields on its edge and back again to the road. The specimen was very fat.

Ferguson (*J.B.N.H.S.*, xv, 662) mentions only 2 specimens of this nightjar from Travancore, both shot on the High Range. He was of the opinion that it did not occur in South Travancore. Kinloch is credited (*Nidification*, iii, 479) with having taken a clutch of 2 eggs in the Nelliampathy Hills in February. This species, however, does not appear in Kinloch's Nelliampathy list (*J.B.N.H.S.*, xxvii, 939-44), and as Mr. Whistler has pointed out (*J.B.N.H.S.*, xxxviii, 35) the record needs confirmation since the parent bird was apparently not collected.

Neither Fairbank nor Terry came across it in the Palni Hills. In Ceylon it is replaced by the typical and darker race *C. m. macrourus*.

Breeding: The gonads of the specimen (12 January) were inactive. There are no published records of its breeding in Travancore, and only the one unconfirmed one from Cochin.

[In *Nidification* (iii, 482) Kinloch is also said to have taken the eggs of *Caprimulgus macrourus albonotatus*, the larger northern race of this nightjar, in the Nelliampathy Hills of Cochin. Confirmation is lacking, but in any case the breeding of both races in the same area seems unlikely.]

Caprimulgus indicus indicus Latham. The Indian Jungle Nightjar.

Specimen collected: 272 ♀ 11-2-33 Thattakād 200 ft.

Elsewhere noted at: Balamore Estate (Ashāmbū Hills, 2,000-3,000 ft.).

Colours of bare parts: Iris brown; fine circumorbital ring yellow; bill horny brown, yellowish on commissure and gape; feet pinkish-brown; claws pale horny brown.

[Additional specimens examined:

Brit. Mus. Coll.: ♂ 29-12-75 Colathoorpolay Valley 1,200 ft. (Hume Coll.); ♀ 2-3-76 Ballochbuir [?] 2,800 ft. (Bourdillon); ♂ no date, ♀ 30-12-79, ♀ 1-11-75, ♀ 29-2-76, ♀ 20-3-76 Mynall 2,000 ft. (Bourdillon); ♀ 23-2-14 Aneichardi Estate (Stewart); ♂ 11-4-83 Pulungi (Terry).

Trivandrum Mus. Coll.: [♀] 29-11-76 Mynall (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.
3 ♂♂	22-23	174-188	125-128 mm.
9 ♀♀	23-24	181-195	(119.5)124.5-132 mm.—H. W.]

The Jungle Nightjar appears to be somewhat erratic in its distribution. It was common in some of the well-wooded portions of Travancore State and apparently absent from others almost identical. The Survey came across it both in the low country and foothills forest (from ca. 200 ft. elevation) in February, up to at least 3,000 ft. in the Ashāmbū Hills in April. Whether or not it is an altitudinal migrant as suggested by Ferguson (*J.B.N.H.S.*, xv, 662), I am unable to say. F. W. Bourdillon (*S.F.*, iv, 381) even says: 'A winter visitor [to Travancore], occurring rather abundantly from November to March and preferring open grassland at the edge of forest'.

At Thattakād these nightjars were commonly seen flying over and across the Periyār River at dusk, from one bank to the other, performing their aerial contortions and hawking winged insects above the water and above the tall trees near its edge. Numbers of these birds roosted during the day among scrub and fallen teak leaves in a teak plantation along the river bank, whence they issued forth at dusk. In the Ashāmbū Hills, on the fringe of evergreen and mixed forest, it was commonly heard calling at dusk and in the early mornings before sunrise. The call-note, as described by me elsewhere, is *chuck-koo, chuck-koo, chuck-koo,* uttered three to seven times, at the rate of one every second or so and then after a short break, repeated again, and so on for several minutes at a stretch. It was the only nightjar heard in this locality.

The Survey did not hear or come across the Jungle Nightjar in Cochin, where, however it must occur since Kinloch is said to have taken its eggs in the Nelliampathies (*Nidification,* iii, 484).

According to Terry (*S.F.*, x, 470) it is common in the Palni Hills especially at Pulungi and Pittur. In Ceylon it is replaced by the endemic insular race *C. i. kelaarti.*

Breeding: The ovary of the specimen (11 February) was undeveloped and the bird was very fat. According to T. F. Bourdillon (*J.B.N.H.S.*, xv, 663) the breeding season in Travancore is January to March. In the Nelliampathies of Cochin, Kinloch took the eggs in February.

[**Caprimulgus monticolus monticolus** Franklin. Franklin's Nightjar.

Not met with by the Surveys, neither has it been recorded by previous observers in Travancore, Cochin or the Palni Hills.

The inclusion of Travancore in its distribution (*Fauna*, iv, 371) rests apparently on the authority of the single specimen (♀) collected by Surgeon-General Fry labelled 'Travancore', now in the British Museum. As is well known, the data on Fry's specimens is not always reliable, and under the circumstances further evidence is desirable before its occurrence in this area can be admitted.]

Caprimulgus asiaticus asiaticus Latham. The Common Indian Nightjar.

Specimens collected: 605 ♀ juv. 17-4-33, 611 ♀, 612 ♂ 18-4-33 Arāmboli 250 ft.; 956 ♀ 8-12-33 Nemmāra at ca. 400 ft.

Elsewhere noted at: Cape Comorin; Trivandrum; Wadakkāncheri (400 ft.); Trichur.

Colours of bare parts: *Adult*: Iris brown; fine circumorbital rim (eyelids) yellow; bill horny-brown, yellowish on commissure and gape; feet pinkish-brown; claws pale horny-brown. *Juvenile*: Iris brown; eyelids (rim) cream colour; bill pinkish-brown, darker at tip; mouth pink; legs and feet pinkish-brown; claws horny brown.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ 5-6-77 eastern base of Palnis (Fairbank).

Measurements:

	Bill.	Wing.	Tail.
2 ♂♂	17-19	138-145	96-104 mm.
1 ♀	—	142	103 mm.—H. W.]

As Ferguson points out (*J.B.N.H.S.*, xv, 662) this little nightjar is very common throughout the low country of Travancore, and to this might also be added Cochin.

Single birds, pairs or loose (family?) parties frequent broken country, fallow and stubble fields, compounds, light scrub or open deciduous jungle at dusk. They squat on the ground or perch on stumps or stones and utter their familiar 'stone-on-ice' calls, *chuck-chuck-chuck-chuck-r-r-* etc. The birds are also invariably seen squatting on motor roads at night—their eyes gleaming red in the beam of the headlights—and flying up just in time to save themselves from the oncoming car, occasionally meeting with disaster. In the early mornings two birds, some distance apart, may frequently be heard answering to each other for long periods.

It apparently does not ascend the Palni Hills either. Fairbank (*S.F.*, v, 393) only obtained a single specimen on the eastern (dry) base of the hills, but saw or heard no other nightjars during five weeks' stay at higher elevations. It is represented in Ceylon by the smaller race *C. a. minor* to which Mysore and Travancore birds approximate in size (*J.B.N.H.S.*, xxxviii, 39).

Breeding: The ovary of No. 956 (8 December) was in a quiescent state. Specimen No. 605 (17 April) was a juvenile with rectrices and wing-quills just sprouting, and it was able to fly short distances with some difficulty. It uttered a quick repeated *chuck-chuck-chuck,* somewhat similar to that of the Painted Sandgrouse, when flushed. Squatting on the ground, it looked exactly like a bit of rotten wood and its colour and pattern blended in a most astonishing manner to render it inconspicuous in its surroundings. From the state of their organs and the fact that they were undergoing body moult post-nuptial, it seemed probable that the two adult April specimens had lately finished breeding.

According to the *Fauna* (iv, 373) this nightjar breeds in Travancore during most months of the year, but most frequently from February to April and then again in July-August.

Lyncornis macrotis bourdilloni Hume. Bourdillon's Great Eared Nightjar.

Specimen collected: 498 ♂ 27-3-33 Tenmalai 500 ft.

Elsewhere not noted.

Colours of bare parts: Iris brown; nostrils and tips of both mandibles blackish-brown; legs pale pink, toes duskier; claws horny brown.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ 4-9-87, ♂ 21-8-87 Konegur (Bourdillon); ♀ (Type) 15-1-75 Kaland, Khauna (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.
3 ♂♂	21-22.5	279-285	182-197 mm.
1 ♀	20	284	186 mm.—H. W.]

Both Bourdillon (*S.F.*, iii, 302) and Stewart (apud Stuart Baker, *Fauna*, iv, 376) seem to have found this large and handsome nightjar fairly common in Central and South Travancore, from sea level up to 2,000 or 3,000 ft. elevation. The type was first obtained by the former (ibid) on 15 January 1875 in a hillmen's clearing on the banks of the Peenaven-aur, about 15 miles north of Mynall, ca. 600 ft. elevation.

Unfortunately the Travancore Survey came across it only at one camp—Tenmalai—in Central Travancore, and although a special look-out was kept for it all along it was neither seen nor heard thereafter. The birds kept during the day to deciduous forest, emerging into glades and clearings soon after sunset with loud whistling calls of two notes: *whi-wheeeew*. The first syllable in this is short and somewhat abrupt, the second much prolonged. Two or three birds could usually be seen of an evening hawking beetles etc. above the tree-tops and jungle, but the species was by no means common.

In a letter to William Davison (*Ibis* 1888, 146-7) T. F. Bourdillon gives the following account of its habits. He writes from Konegur, where he obtained a specimen: 'It seems to be local but not uncommon where it does occur, for I have seen one or two every night for the last two or three weeks since I have been here. They come out, however, very late; just as the last tinge of colour is fading out of the sky one may see one or two of these birds sailing over the fields, seldom flapping their wings, but quartering the ground like a harrier. They do not remain in one place, but travel about a good deal, but seem to return to the same neighbourhood night after night unless one is shot, when they all disappear for four or five days. As a rule they fly slow, at about the same pace as a harrier, except when moving from one place to another, when they go at a great pace, striking the air with vigorous wings.'

This nightjar appears to be confined exclusively to Central and South [?] Travancore. Neither Kinloch nor the Cochin Survey came across it in that State, and it does not occur in Ceylon.

Breeding: The testes of the specimen (27 March) measured 6 × 4 mm. It was very fat, in fresh plumage and presumably preparing to breed shortly. According to the *Fauna* (iv, 376) J. Stewart took a fine series of the eggs of this bird in Travancore between January and the middle of May. He found it breeding generally in bush cover on broken hillsides, but also in deciduous forest in thin undergrowth.

SUB-ORDER: PODARGI.

FAMILY: PODARGIDÆ.

Batrachostomus moniliger Blyth. The Ceylon Frogmouth.

Specimens collected: 220 ♀, 221 ♂ 4-2-33 Thattakād 200 ft.

Elsewhere not noted.

Colours of bare parts: Iris pale khaki or brownish-buff; bill pale horny, yellowish at gape and chin; mouth pale sulphur yellow; gullet pink; feet dusky yellow; claws brownish.

[Measurements:

	Bill.	Wing.	Tail.
1 ♂	23	122	100 mm.
1 ♀	23.5	127	110.5 mm.

Additional specimens seen:

Brit. Mus. Coll.: ♂ 2-3-76, ♀ 19-12-74 Mynall (Bourdillon); [♂♂♀] no date Aneichardi Estate (Stewart); [♂♀] 17-1-15 Venture Estate (Stewart). —H. W.]

The Frogmouth is undoubtedly rare in Travancore and there is no record of it from Cochin. The specimens were put up in dense evergreen scrub and secondary jungle with cane-brakes etc. (see photo, Plate ii with Part I) a few feet off the edge of the now more or less deserted old High Range road. They were quite accidentally come upon, happening to be on the very square yard of ground on which an Iora fell when shot! One of the birds flew up and perched crosswise—like a Passerine bird—on a cane stem a short distance away, screwing its head right round like an owlet to watch the intruder. I did not hear its call and its description appears to be doubtful, but according to the *Fauna* (iv, 382) it has been likened to a soft *kooroo-kooroo* repeated several times.

It has not been recorded in the Palni Hills. The same form is resident in Ceylon.

Breeding: The ovary of the female contained a soft egg measuring 11 mm. in diameter. Its oviduct was very distended, indicating that it had laid. The testes of the male, however, which was evidently the mate of No. 220—as the birds were together—measured only 6 × 4 mm. This discrepancy in the development of the gonads of the birds, if a pair, seems remarkable.

According to Bourdillon (*J.B.N.H.S.*, xv, 663) it breeds in Travancore at elevations of 2,000 to 3,000 ft. from January to the end of February. Stewart, however, has taken eggs from January to May and again in September and October (*Fauna*, iv, 382).

The nest is a pad of moss, leaves, twigs and the bird's down, placed in the fork of small trees 12-16 ft. from the ground, in evergreen jungle, occasionally in deciduous forest, and is conspicuous and without concealment.

SUB-ORDER: STRIGES.

Family: Tytonidæ.

Tyto alba stertens Hartert. The Barn Owl.

Specimens collected: 843 ♂, 12-8-33, 845 ♀ 13-8-33 Beach, Trivandrum, ca. S.L.

Elsewhere not noted.

Colours of bare parts: '♂ Iris crimson and black; bill bluish-white, darker at tips; mouth pink; claws horny black. ♀ Iris bluish-black; bill bluish-white; mouth flesh; claws horny black' (Pillai).

[Only one additional specimen seen:

Brit. Mus. Coll.: ♂ Travancore (Fry).

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
2 ♂♂	34-37	281-288	111-115.5	70 mm.
1 ♀	36.5	278	114	60 mm.—H. W.]

The Barn Owl seems to have been overlooked by the Surveys proper between November and May. Ferguson says (*J.B.N.H.S.*, xv, 667) that it is found occasionally in the low country of Travancore, about human habitations, and to this the two specimens procured by Mr. Pillai in Trivandrum testify. There is nothing on record about its occurrence or status in Cochin, but it is doubtless the same as in this adjoining area.

Mr. Pillai notes that both the birds were shot from an old uninhabited palace by the sea. In the stomach of the female he found the remains of a rat (species?).

In the island of Ceylon the same race is said to occur, but its distribution there seems to be almost limited to the Jaffna Peninsula.

Breeding: The testes of the male measured 19 × 4 mm. The ovary of the female appeared to be maturing, the largest follicles being about 3 mm. in diameter.

According to Ferguson this owl breeds in Travancore during December and January, but the evidence furnished by the specimens suggests that the season is not restricted to those months.

[**Tyto longimembris** (**longimembris** Jerdon). The Grass Owl.

Not recorded from Travancore or Cochin, but Terry (*S.F.*, x, 469) says he flushed an owl in the long grass on a hill-side at Pulungi in the Palni Hills which he thought undoubtedly belonged to this species.]

Family: Asionidæ.

Asio flammeus flammeus (Pontopiddan). The Short-eared Owl.

Specimen collected: 338 ♀ 23-2-33 Peermade, at 4,000 ft.

Elsewhere noted at: Sānthanpāra (3,500 ft.—Cardamom Hills); Karūpadanna (ca. S.L.).

Colours of bare parts: Iris bright lemon yellow; bill slaty-black; mouth livid pink; exposed portion of toes dark brown; soles dirty pale flesh colour; claws horny black.

[Only other specimen from Travancore seen:

Brit. Mus. Coll.: o? 28-12-75 Colathoorpolay Valley, 3,000 ft. (Bourdillon).

The Survey specimen measures:

Bill.	Wing.	Tail.
29	290	139 mm.—H. W.]

Ferguson (*J.B.N.H.S.*, xv, 667) did not come across this owl in Travancore, but mentions that F. W. Bourdillon shot a single specimen at 4,000 ft. elevation at the end of December. Elwes (*Ibis* 1870, 527) also found it in the Cardamom Hills.

As a winter visitor this owl is probably found in small numbers in our area, but it is on the whole rare. In the Nelliampathy Hills Kinloch (*J.B.N.H.S.*, xxvii, 942) considered it 'very rare indeed'.

The specimen was a solitary bird on an open grass-covered hillside dotted with stunted trees of *Phoenix farinifera* near the Pir's tomb, at about 4,000 ft. elevation. It was very wary and flew about in bright sunlight without apparent discomfort, perching on stones or at the base of tussocks of the coarse *Andropogon* grass. Another single bird was flushed at the same altitude and in identical facies in the Cardamom Hills (25 January), while a third specimen—also solitary—was observed on the grassy laterite plateau adjoining the Travellers' Bungalow at Karūpadanna (ca. S.L.—30 December). No other examples were seen.

It has not been recorded from the Palni Hills by Fairbank or Terry, but Hume (*S.F.*, x, 343) says that it occurs there. It is an irregular winter visitor to Ceylon.

The ovary of the specimen was undeveloped but distinctly granular. The bird was undergoing body moult (pre-nuptial?).

Strix indranee indranee Sykes. The Brown Wood Owl.

Specimen not obtained. Not included in Ferguson's Travancore list. According to the *Fauna* (iv, 400) in Malabar and Travancore this owl seems to be found from the lowest to the highest hills, both in forest and in well-wooded country. Bourdillon is credited with having obtained its eggs in Travancore in January and March.

Strix ocellata (Lesson). The Mottled Wood Owl.

Specimen collected: 1032 ♂ 28-12-33 Karūpadanna ca. S.L.

Elsewhere noted at: Arāmboli (250 ft.); Nemmāra (300 ft.); Trichūr.

Colours of bare parts: Iris dark brown; eye-lids dusky pink; bill and claws horny black; toes brownish-flesh.

[The specimen measures:

Bill.	Wing.	Tail.
41.5	333	178 mm.

This species has no races. I cannot detect any difference between the Survey bird and the only Travancore specimen in the British Museum (viz. Fry Collection—no data. The moults have not yet been worked out for lack of specimens).—H. W.]

The Mottled Wood Owl seems to be confined to the low country in Travancore and Cochin, where it is probably not uncommon. Ferguson's collectors shot two specimens on an island in the Vembanād Backwaters in January 1903, and he describes the species as fairly common from Arukutty to Vycome (*J.B.N.H.S.,* xv, 667).

The specimen was one of a pair in an ancient tree in a cocoanut plantation around a backwater homestead. Its stomach contained remains of a field mouse and a large scorpion with sting intact! Ferguson's specimens had eaten crabs and beetles.

Its quavering, somewhat eerie call *chūhūā-ā* was chiefly heard at dusk and in the early mornings, just before the birds emerged from their daytime retreats, or retired to them. The call uttered throughout the night is usually a metallic hoot, not unpleasant to the ear.

The southern range of this owl as limited in the *Fauna* (iv, 403) to 'the Carnatic and to the base of the Nilgiris' must be extended to include the entire southern extremity of the Peninsula. The species has not occurred in Ceylon.

Breeding: The testes of the specimen had enlarged to 10 × 5 mm. (grey pigmented), and it was apparently preparing to breed. Ferguson's statement that the eggs of this owl were brought to Bourdillon by the hillmen in June cannot be accepted as authentic in the absence of more reliable data.

(*To be continued*).

THE FOXES OF BRITISH INDIA.

BY

R. I. Pocock, F.R.S.

(From the Zoological Department of the British Museum, Natural History).

(With three text-figures).

In his volume on the *Mammals of British India* Blanford admitted five species of Foxes under the following names:—the Indian Fox (*Vulpes bengalensis*), the Hoary Fox (*V. cana*), the Indian Desert Fox (*V. leucopus*), the Common Fox (*V. alopex*) and the Small Tibetan Fox (*V. ferrilatus*). It cannot be claimed that the popular names were all well chosen. *V. bengalensis*, it is true, may be regarded as the Indian Fox *par excellence* because it is restricted to Hindostan, whereas the others are aliens from the north and north-west and never penetrated far into the country. Moreover *V. bengalensis* lives alongside *V. leucopus* in Rajputana and Sind and in those districts is as deserving of the name 'Indian Desert Fox' as the latter. The name 'Common' was applied to the large Himalayan Fox because Blanford, quite correctly in a sense, thought it was the same as the ordinary European Fox. It is in reality a local race of it and 'Hill Fox' would be a much better term so far as India is concerned. 'Small Tibetan Fox' is also misleading because the species is about as large as the Hill Fox which also occurs in Tibet. It may more appropriately be called the 'Tibetan Desert Fox' because its colouration suggests that environment. As for the 'Hoary Fox' since that epithet is not half so appropriate for this pigmy Afghan fox as for the larger species of that country, I propose to name it 'Blanford's Fox'.

Only two of the scientific names used by Blanford have to be altered. His *V. alopex* becomes *V. vulpes montana*, which expresses the view that the animal is a local race of *V. vulpes* which ranges from Europe through Central and Northern Asia into North America; and his *V. leucopus* becomes *V. vulpes pusilla* because this fox also is nothing but a local race of *V. vulpes*, not a distinct species in the sense that *bengalensis*, *cana* and *ferrilata* are distinct; and also because the name *pusilla* was printed before *leucopus* and therefore has the claim to admission. Thus Blanford's five species are reduced to four; but one of them, namely *V. vulpes*, is represented by three definable local races.

In this, as in other papers of mine, on the *Mammals of British India* published by the Bombay Natural History Society I have made as much use as space permits of the very valuable and instructive details regarding dates, measurements and so forth contained on the labels of the splendid collection of skins procured by the 'Mammal Survey' of British India organised by the Society. Similarly detailed dimensions of a considerable number of the skulls are given to show their variations. It may be thought that the tables of measurements are unnecessarily long; but nothing is more irritating and unsatisfactory in systematic descriptions than such general statements as that one species, or race, differs from another by having a larger or smaller skull or teeth, without the addition of actual measurements to show the points. Tables also have the advantage of showing at a glance the very considerable individual variation of foxes from the same locality and obviously belonging to the same race. Similar variations in the skulls and teeth in foxes from different localities have been used for the establishment of distinct species and races.

Genus: VULPES, Oken.

Vulpes Oken, *Lehrb. Naturg.* iii, pt. II, pp. 1033-4 (1816); Miller, *Cat. Mamm. Centr. Europe*, p. 325 (1912).

Type of the genus: *Canis vulpes* Linn.

Distribution: The greater part of the old world, except Madagascar, S.-E. Asia and Australasia, and of N. America as far south as Mexico.

Distinguished from *Canis* and *Cuon*, the other genera of *Canidae* inhabiting British India by having the forehead of the skull between the postorbital processes flat, not inflated by air-cells, the processes themselves slightly concave, with raised anterior edge, instead of convexly rounded, and the canine teeth typically longer, the upper with their points reaching as low as the inferior margin of the mandible, and the points of the lower reaching well above the line of insertion of the upper incisors.

Key to the Species based on external characters.

A. Tail and ear long, tail over half the length of the head and body, ear much more than half the length of the hind foot.
  1. Tip of the tail white; upper half of back of ear black and strongly contrasted with tint of head and nape (four pairs of mammae) ... ... *vulpes.*
  2. Tip of the tail black; backs of the ears generally nearly the same tint as the head and nape, never jet black and strongly contrasted.
    a. Larger; coat never very long and full; colour brownish or ochreous on the back, the contour hairs always with pale band giving a speckled look to the pelage (three pairs of mammae) ... *bengalensis.*
    b. Smaller; coat very long, full and loose; the contour hairs extensively white and black so that the pelage is never closely speckled ... ... *cana.*

B. Tail and ear short, tail less than half the length of the head and body; ear less than half the length of the hind foot ... ... *ferrilata.*

Key to the Species based on the skull and teeth.

A. Muzzle comparatively short and broad, its width above pm^2 about one-third the length of the palate; canines moderately long, height of upper from base to point less than combined lengths of upper carnassial (pm^4) and first molar (m^1) as set in jaw.
  1. Nasals on the average narrower posteriorly; the upper carnassial relatively larger as compared with the first molar.
    a. Skull in smallest ♀ over 100 mm. in condylobasal length ... ... *vulpes.*
    b. Skull in adult ♂ up to about 90 mm. ... *cana.*

2. Nasals on the average broader posteriorly and upper carnassial smaller as compared with first upper molar ... ... *bengalensis*.

B. Muzzle long with concave lateral margins, its width above pm^2 about one-quarter the length of the palate; canines very long, height of upper exceeding combined lengths of pm^4 and m^1 ... ... *ferrilata*.

Vulpes vulpes, Linn.

Canis vulpes Linn., *Syst. Nat.*, ed. 10, vol. i, p. 40 (1758). [For descriptions and full synonymy of typical *Vulpes vulpes* from Sweden and of related European forms, see Miller, *Cat. Mamm. Western Europe*, pp. 330-40 (1912).]

Locality of the type: Sweden.

Distribution: Europe from the Arctic coast to the Mediterranean and Africa north of the Sahara; Asia from the far north to S. Arabia, N.-W. India, the Himalayas, S. China and Tonquin and the greater part of N. America from the Arctic coast southwards to California. Absent from the greater part of Peninsular India, Ceylon, Burma, Malaya, Siam, Sumatra, Java and Borneo. The range agrees on the whole very closely with that of the Wolf (*Canis lupus*) and of the Bear (*Ursus arctos*), but is more extensive at all events to the south.

Distinguished by the combination of black backs to the ears and a white tip to the tail; although commonly called the 'red-fox', on account of the dominance of that tint, the colour is very variable both individually and locally, the contour hairs of the back being sometimes flavescent, 'silvery' or black to a varying extent. The size is also variable. Although typically considerably exceeding on the average that of other species, some of the sub-species are comparatively small. Usually at all events there are four pairs of mammae in the ♀.

Vulpes vulpes montana, Pearson.

THE HILL FOX.

'The Hill Fox' Royle, *Journ., As. Soc. Beng.*, vol. i, p. 99 (1832).

Canis vulpes montana Pearson, *Journ., As. Soc. Beng.*, vol. v, p. 313 (January 1836).

Canis himalaicus Ogilby, *Proc. Zool. Soc.*, p. 103 (October 1836); and in Royle's *Botany of the Himalayas, Mamm.*, p. lxvi (1839).

Vulpes nepalensis Gray, *Charlesw. Mag. Nat. Hist.*, vol. i, p. 573 (1837).

Vulpes alopex Blanford, *Mamm. Brit. India*, p. 153 (1881).

Vulpes vulpes waddelli Bonhote, *Proc. Zool. Soc.*, p. 303 (1906).

Vulpes ladacensis Matschie, *Filchner's Exped. Chin.*, p. 167 (1907).

Locality of the type of *montana*, 'Himalayas'; of *himalaicus*, Mussoorie; of *nepalensis*, Nepal; of *waddelli*, Kambajong, Tibet; of *ladacensis*, Ladakh.

Distribution: Himalayas from Gilgit eastward to Sikhim; Tibet and Yunnan.

Distinguished from the typical Scandinavian race and the other races of Continental Europe admitted by Miller by its smaller size on the average, especially indicated by the skull and teeth (see p. 42).

Notes on the synonymy: The type of *montana*,[1] of which the exact locality is unknown, was described as having a dark rufous cross on the back set off by light fawn on the neck and behind the shoulders; the sides of the body and the shoulders being grizzled and the underside dark. Blyth, who had Pearson's type and stated that the fox occurs at Simla and Mussoorie, described it as much less rufous than the European fox and paler and more hoary [*Journ., As. Soc. Beng.*, vol. xxiii, p. 730 (1854)]. He also astutely suggested that it might prove to be the same as the large fox of Afghanistan described by Griffith. From the description it appears that this fox comes between the 'red' and the 'hoary' types since it agrees tolerably closely with skins from Kangra, Chamba and Simla referred to below.

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[1] Wrongly stated by Mivart [*Mon. Canidae*, p. 96 (1890)] to be in the British Museum.

The type of *himalaicus*, from Mussoorie, was described as bright bay on the back, yellowish on the sides of the body, white on the side of the neck, hoary grey on the hips and smoky brown below. Ogilby's type, which is in the British Museum, is now tawny red above, with hardly a trace of black, but with some buffy white on the loins, isabelline on the flanks, silvered and hoary on the thighs, sooty below, set off by bright buff on the chest. Although both Ogilby and Blyth considered *himalaicus* to be a synonym of *montanus*, the two types do not agree in colouration, *himalaicus* belonging to the first category mentioned below.

The type of *nepalensis*, one of Hardwicke's Nepalese specimens of which the whereabouts is unknown, was described as bright fulvous yellow above, like the English fox but with the fur brighter and much softer. According to Blyth [*Journ., As. Soc. Beng.*, vol. xxiii, p. 730 (1854)] this is a large fox with very fine, long, dense fur, bright light yellowish fulvous in colour and with a huge brush. According to him it occurs in Tibet, rarely south of the snows. Possibly Hardwicke's specimen was a traded skin; but the description agrees very closely not only with some Tibetan skins in the British Museum but with one from Sikhim and some from Kumaon as stated below.

The type of *waddelli*, from Kambajong, Tibet, 16,400 ft., was regarded by Bonhote as distinct from *montana* because it represented a redder type than any of the Himalayan skins in the British Museum at that time. It is not redder, however, than skins from Sikhim, Kumaon and elsewhere subsequently received.

The name *ladacensis* was given by Matschie to a skin from Ladakh which he thought was specifically identical with the paler of the two foxes collected by Stolicka in Turkestan and illustrated by Blanford (Fig. 1, Pl. II) in the report on the Second Yarkand Mission, 1891. Matschie was apparently quite unaware of the individual variation in the colour of foxes. There is no doubt that the two foxes depicted on the plate by Blanford merely represented colour phases of one and the same subspecies, comparable with 'red' and 'flavescent' phases of *montana* from Kumaon, Sikhim and Tibet, although Matschie regarded them as specifically distinct. I have seen no foxes from Ladakh, but one from Gilgit, in the same river valley, is inseparable from *montana*.

The British Museum has the following Himalayan skins:—

Sikhim, Kapup, 13,000 ft., Ad. ♂ (Crump coll.), November 24th, in fresh winter coat is bright reddish bay from nape to loins with scarcely any black or buff or grey areas in the contour hairs, but the forehead and cheeks have a good deal of whitish; the thighs are hoary grey, the underside white, the top of the tail red, and the fore legs darkish tawny, with a grizzled black streak to wrist; hind legs paler.

Sikhim, Thanga, in the Upper Chambi Valley, 11,000 ft., Ad. ♀ (Crump coll.), January 4th, in mid-winter coat, is much paler and yellower, the contour hairs bleached to buff on the back, the bright tint being restricted to the back, with the flanks greyish; the fore legs also are much paler; the underside is white.

Tibet, Kambajong, 16,400 ft., Ad. ♂, Oct. 8th (type of *waddelli*), is very like the Kapup skin, but has the contour hairs on the flanks paler. A second skin named *waddelli* by Bonhote, from Pharijong, January 11th, is like the Upper Chambi skin, but rather brighter. Two undated skins labelled Tibet (Hodgson) are also a little brighter and more golden than the Chambi skin, the three being intermediate between the two skins assigned to *waddelli*. An adult ♂ from Dachin, Tibet, 14,700 ft. (Col. Bailey), June 22nd, is in full moult, all the contour hairs of the back being shed, leaving a thick coating of tufted dark, chocolate wool. Another ad. ♂ from Gyantse, 13,000 ft. also from Col. Bailey, undated, is in much the same condition but a few contour hairs, with the tips bleached white, dead and shrivelled, remain.

All these skins are white-bellied. The redder of them belong to the phase represented by the type of *himalaicus* and the paler agree precisely with Gray's description of *nepalensis*.

No fox of this type has been recorded from Bhotan, Assam or Upper Burma; but it occurs in Yunnan, whence the Museum has two skins, both from Tengyueh, an adult ♀, 9,000 ft. (Howell), February 11th, which is an almost exact match of the skin from Kapup in Sikhim; and an ad. ♂, 6,000-7,000 ft. (Forrest), dated December 24th, but almost certainly wrongly, because the whole of the back behind the shoulders is covered with brown wool with a few white-bleached contours, as in Col. Bailey's Tibetan skins; but the nape and shoulders still retain the long fluffy contours, resembling in colour the paler skins of the *nepalensis* type from Tibet and Sikhim.

Kumaon: A series of six skins (Crump) closely resembles those described above. The extremes in colour are an ad. ♂ from Lohaghat in Almora, 5,600 ft., February 6th, which is dark reddish bay above from the head to the tail-root as in the skin from Kapup, Sikhim, but there are some black tipped hairs on the nape and shoulders and the belly is mostly blackish; and an ad. ♀ from Champawat in Almora, 5,850 ft., February 21st, which is much paler, with the general colour above buffy yellow, the fur of the back grey-brown, instead of sooty and the throat and chin and greater part of the belly white, with some dark grey on the chest. A second from Lohaghat closely matches the Champawat ♀. Two ad. ♂ skins from Takula, 5,350 ft., October 12th and 15th, are like the first described ♂ from Lohaghat, whereas a ♀ from Takula, October 12th, is paler, intermediate between the ♂ Takula skins and the pale ♀ from Champawat.

These skins also exhibit the colour phases represented by the types of *himalaicus* and *nepalensis* respectively.

Mussoorie: In addition to the type of *himalaicus* above described the Museum has another skin 5,500 ft. (Hutton) which is very like it, but has more white banding in the contour hairs of the hind quarters, and is white below in the middle line instead of slate grey.

Simla: A series of four skins (Hume) shows great individual variation. Two, ♂, ♀, closely resemble the Mussoorie skins, another ♀, September 28th, is much darker, all the hairs of the dorsal surface being black-tipped and buff below the tip, the general effect being grizzled brown from the crown backwards. Another ♀, September 26th, is still darker than the last, the pale areas of the contour hairs being much less evident, especially on the nape and shoulders, which are heavily blackened; the underside is sooty and the legs are very dark. The general effect is a blackish fox, speckled with buff or grey, with a brighter buffy cross-mark down the spine and across the shoulders. Another ♀ skin (Blanford), October, is short coated and marked above with a dark rusty red cross showing no buff or black speckling; the thighs and fore legs are blackish speckled with white. This skin of Blanford's agrees very closely with the type of *montana* as described by Pearson, but neither appears to be in complete coat, judging from the distinctness of the 'dark rufous' cross mark on the back; and it is evident from Blyth's description of the foxes from Simla and Mussoorie that the skins he saw and described as much less rufous, paler and more hoary than European foxes, belonged to the type prevalent at Kangra and Chamba.

Kangra Valley: Four skins (Wells coll.) in good coat are of the 'crossed or decussate', hoary type with the bright colouring reduced on the back and the contour hairs marked with a broad whitish band and a black tip, the black often dominant. Ad. ♂ from Gopalpur, 6,000 ft., February 29th, is dark reddish tan down the back with abundance of black but not much of the pale tint; flanks grey; thighs and shoulders hoary; underside smoke-grey; fore legs dark hoary, with dark tan paws; hind dark tan with dark hoary patch. A second ad. ♂ from the same locality, 5,600 ft., February 18th, is a good deal paler above than the last, but has more black on the limbs. Ad. ♀ from Sanyala, 4,500 ft. May 8th, is still paler, yellowish down the back, with the dark hair-tips scarcely evident, but the thighs and sides of the shoulders hoary, the throat sooty and the abdomen covered with short red hairs in preparation for suckling. An undated skin from Baijnath is very dark with a dull ochreous tint in the dorsal contour hairs and the fur nearly black.

Chamba: A series of nine skins collected by Wells in December and January between 4,000 and 5,000 ft. Two only, one from Pukri, 4,000 ft., and another from Bara Tissa, 7,500 ft., are of the reddish type like the richer skins from Kumaon. The rest from Pukri, Bara Tissa, Chalan Tissa, 6,700 ft., Chatri, 5,000 ft., and Siluni, 5,000 ft., are darker with the bright colour on the back not so red, but varying from ochreous to reddish brown and more restricted, forming a broad band or cross, more or less obscured by the black tips of the hairs; the thighs, flanks and sides of the shoulders hoary. These are like the dark Kangra skins.

Gilgit: Two skins of the red and paler phases, like those of Tibet, Sikhim and Kumaon. One 5,000 ft. (Biddulph), October 7th, in fresh winter coat has the contour hairs of the back tolerably uniformly red without appreciable pale areas or black tips; the underside has the throat ashy, the abdomen ashy overcast with white and the inguinal region white; the legs have some black and white hairs on their front surfaces. The second, 6,000 ft. (Major W. F. R. Trevelyan), is in full moult, most of the contour hairs being shed, leaving the woolly coat exposed. The coloured area of the back is reduced in extent and not so red as in Biddulph's skin, the general tint being faded to bright ochreous, with the head still paler; the rest of the upper side is covered with thick tufted wool, white on the sides of the neck and flanks, pale sooty on the hind back; the under side is ashy; the legs are more heavily pigmented in front than in Biddulph's skin and the tail is mostly covered with white wool.

From the evidence of the skins, mainly collected by the Mammal Survey, it seems that the Hill Fox undergoes remarkable change in colour when traced westwards through the Himalayas from Tibet and Sikhim. The eastern form varies from bright reddish bay to bright yellowish fulvous, with scarcely a trace of black and very little silvery white in the pelage. The reddish phase was named *himalaica* and the fulvous or flavescent *nepalensis*. These are the only phases hitherto recorded from Sikhim and Kumaon. But the red phase also occurs in Mussoorie, Chamba and Kangra. In these districts, however, the 'hoary' phase, described as *montana,* and distinguished by the reduction of the bright hue of the back and by the generally black and white colouration of the contour hairs of the flanks and elsewhere, is prevalent. These may prove to represent distinct races, *himalaica* and *montana*, but for the present I prefer to regard them as one, since in N. America the 'red', the 'hoary' and the 'black' or silver-tip phases occur in the same locality. But I have given racial status to a still more hoary form found to the west of Chamba and Kangra and typified by a fox originally recorded from Kandahar and named *griffithii.*

The following are the flesh-measurements converted from millimetres into English inches and some weights of the largest and smallest males and females of *montana* from each district:—

...	Head and Body	Tail	Hind foot	Weight
Sikhim, Kapup ... ad♂	$27\frac{1}{5}$	$17\frac{4}{5}$	$6\frac{3}{5}$	...
,, Thanga ... ad♀	$24\frac{2}{5}$	$15\frac{3}{5}$	6	$8\frac{3}{4}$ lbs.
Kumaon, Almora ... ad♂	25	$16\frac{4}{5}$	6	$10\frac{1}{4}$,,
,, Takula ... ad♂	$22\frac{4}{5}$	$17\frac{1}{5}$	(4–)	$10\frac{1}{2}$,,
,, ,, ... ad♀	$23\frac{1}{5}$	$15\frac{4}{5}$	$5\frac{3}{5}$	$8\frac{1}{2}$,,
,, Almora ... ad♀	$22\frac{2}{5}$	14	$5\frac{2}{5}$	8 ,,
Kangra, Gopalpur ... ad♂	28	18	6	...
,, ,, ... ad♂	$26\frac{4}{5}$	$17\frac{4}{5}$	$5\frac{4}{5}$	$11\frac{1}{4}$ lbs.
,, Samyala ... ad♀	$24\frac{4}{5}$	$13\frac{2}{5}$	$5\frac{2}{5}$	8 ,,
Chamba, Pukri ... ad♂	$29\frac{3}{5}$	18	6	...
,, Bara Tissa ... ad♂	26	$14\frac{4}{5}$	$5\frac{2}{5}$	...
,, Chalan Tissa ... ad♀	26	$13\frac{3}{5}$	5	...
,, ,, ,, ad♀	$25\frac{1}{5}$	$16\frac{1}{5}$	$5\frac{4}{5}$	8 lbs.

The ear is usually about $3\frac{1}{2}$ in. long, measured from the notch, but may be 4 in. (100 mm.).

The table suggests that the foxes from Kangra and Chamba are bigger, sex for sex, than those from Kumaon, but since this is not borne out by the skulls the apparent difference is probably due to the 'personal equation' of the collectors, Wells and Crump, respectively.

Of the measured Tibetan skins Col. Bailey's ad. ♂ from Dachin and the type of *waddelli* from Kambajong have a head and body measurement of 26¾ in. and 25 in. respectively; and the ♂ and ♀ skins from the Tengyueh Valley in Yunnan are exactly the same in head and body as the ♂ and ♀ from Sikhim. The tails and hind feet of these Tibetan and Yunnan skins similarly agree very closely with those of the Sikhim and Kumaon skins.

From the available data it does not appear that the flesh-measurements of this fox are appreciably less than those of the Continental European foxes, although the skulls as recorded below are decidedly smaller.

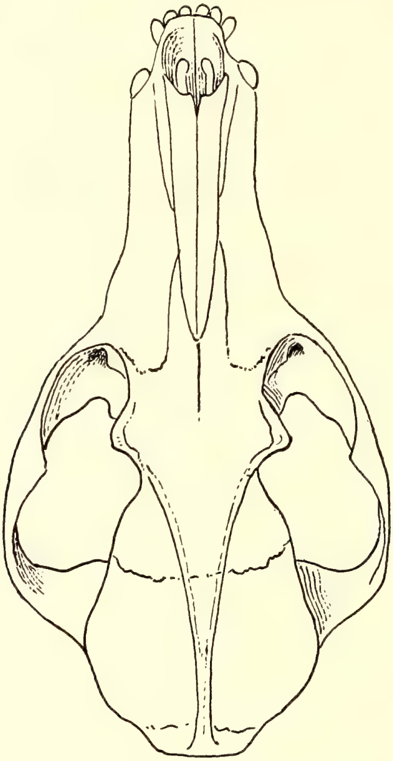

Fig 1.—Skull of ad. ♂ of *Vulpes vulpes montana* from Takula, Kumaon, ×⅓

Skulls of *montana*, sex for sex, are smaller on the average than those of the three British and Continental European races of *V. vulpes,* admitted by Miller, namely *V. v. vulpes* from Scandinavia, *V. v. crucigera* from Central Europe and Italy and *V. v. silacea* from Spain which are closely related. In ♂ skulls of *montana* the condylobasal length varies from 128 to 141 mm. with an average of about 136 mm., the same measurement for ♀ skulls being from 123 to 132 mm. and the average about 130 mm. In the European races ♂ skulls range from 136 to 155 mm., with an average of about 145 mm., and ♀ skulls from 126 to 141 mm. with an average of about 134 mm. The teeth also of *montana* appear to be similarly a little smaller, especially the upper carnassial (*pm*^{4}).

In the table of skull measurements of this race (p. 45) the zygomatic and the postorbital, or 'waist', widths are entered because it is customary to record them. They are, however, of very little use because they vary with age after the skull has attained its full length, the zygomata becoming wider and the postorbital area narrower from muscular moulding as the skull gets older.[1]

The two skulls from Simla, which have no skins, were collected by B. B. Osmaston. It may be added that the two unsexed skulls of Bailey's Tibetan specimens, above referred to, have a condylobasal length of 134 and 139 mm. respectively, that the adult ♂ skull of the type of *waddelli* is 136 mm. and the ad. ♂ and ♀ skull from the Tengyueh Valley in Western Yunnan are respectively 139 and 130 mm. with a mandibular length of 110 and 104 mm. All these skulls fit in with the Himalayan series of *montana*. Finally the skull belonging to the skin collected by Biddulph at Gilgit, although immature and defective, has the upper carnassial (pm^4) and the upper molar (m^1) the same size as in *montana*.

Vulpes vulpes griffithii, Blyth.

Vulpes flavescens Hutton, *Journ., As. Soc. Beng.*, vol. xiv, p. 344 (1845), (with descriptive note by Blyth); Blyth, *Journ., As. Soc. Beng.*, vol. xxii, p. 581 (1853), (not *flavescens* Gray).

Vulpes griffithii Blyth, *Journ., As. Soc. Beng.*, vol. xxiii, p. 730 (1854); Scully, *Ann. Mag. Nat. Hist.* (5), vol. viii, p. 226 (1881).

Locality of the type: Kandahar in Afghanistan.

Distribution: Southern Afghanistan, Waziristan and Murree.

A trifle smaller on the average, judging from the few available skins, than *montana*, and, although exhibiting the red phase, typically extensively hoary and silvered with the brighter tint reduced to a wash of pale ochreous forming a narrow band down the back, considerably paler and less extensive than in the Chamba skins of *montana*, but intergrading with the latter and also with the next race *pusilla* both in the Punjab and Baluchistan.

Hutton, who was the first to give an account of this fox, said:—'The fox of Afghanistan, or at least of the southern and western parts, is apparently the same as our Himalayan species, though somewhat less in size. . . It is common in the valleys round Kandahar hiding in burrows and holes, in rocks'. He gives, however, measurements of two ♀ specimens which show equality in size to ♀ *montana*. In a note to Hutton's account, Blyth, to whom Hutton sent the type, quoted Griffith's statement that 'a large and small species of fox appear to exist in Afghanistan. The former perhaps is the same as the Large Himalayan Fox found at Quetta and Olipore. The small seems to resemble the fox of the plains of India.' Blyth, quite wrongly, I think, identified Hutton's specimen, for which he adopted the name *flavescens*, as the Small Afghan Fox described by Griffith;[2] but he described it as having 'the longer hairs black-tipped, yellowish white along the back, white on the sides, the face fulvous with a blackish patch on the muzzle, the fore leg blackish in front, the hind paw with a blackish spot above and the under side dusky.' In the following year he named this fox *griffithii*. Later Scully repeated the information supplied by Hutton[3] and Blyth about the fox and gave some measurements of a skull from Kandahar which he referred to *montana*.

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[1] Here and elsewhere in this paper the maxillary width is the width of the muzzle above the root of the canines; the upper cheek teeth are measured from the crown of the last tooth (m^2) to that of the canine; the mandible from the condyle to the sockets of the incisors; the upper carnassial (pm^4) and the first molar (m^1) along their outer margins and the lower carnassial (m_1) along its middle line.

[2] This was no doubt the species subsequently named *Vulpes cana* by Blanford (see below, p. 53).

[3] The length of the tail given by Hutton as 17 in. was misquoted, or misprinted, by Scully as 27 in.

Blanford, misled by Blyth's identification of Hutton's Small Kandahar Fox as *griffithii*, wrongly identified the latter as *leucopus* (=*pusilla*).

The British Museum has the following skins:—

Wano in Wazaristan near the Afghan-Baluchi border. A young ad. ♂ (W. B. Cotton), December 19th, has a faint ochreous wash from the nape forming a narrow band down the back but scarcely traceable on the loins; the head and face are tan with a conspicuous black patch on the muzzle; the fore legs are tan with some grey down the front and a pale grey patch on the paws; the hind legs cream-buff with no black and the whole of the under side is sooty. This specimen agrees very closely with Blyth's description of the type of *griffithii*.

Gharial in the Upper Punjab, near Murree, 7,000 ft. An ad. ♀ (Major Dunn), July 27th, differs from the last in having a lighter muzzle patch, the hairs of the crown more bleached and worn and the ochreous wash only traceable behind the shoulders but stronger on the loins than in the Wazaristan skin; the black is more dominant on the nape and shoulders which are blacker than the hoary flanks; the fore legs are deep tan with a conspicuous blackish grey streak down the front; the hind whitish below the hocks in front with some infuscation and the abdomen, covered with short new hair, is white, the chin also is white but some old hair adhering to the throat and the chest is smoky grey.

Kotli in the Murree Hills, 5,800 ft. (Wells). An ad. ♂, June 19th, is changing coat, with some long contour hairs, retained on the back, dark tipped, with white, or on the back buffy, subterminal band; but wherever the new coat is exposed above, i.e. on the head, thighs, back etc., it is ochreous whereas on the chest and belly it is white; the legs are as in the Gharial skin, but there is practically no bright colour on the tail above except at the base. The appearance of this skin suggests that, with the moult completed, it would be indistinguishable from the skins in summer coat of the two examples of the next race, *pusilla*, collected at Ava in the Salt Range by Col. Stockley.

Murree, 7,000 ft. (Dr. J. E. T. Aitcheson). An ad. ♂ resembles the Sikhim and Kumaon and a few of the Chamba skins in exhibiting the red phase of colouration.

The only available flesh measurements, in English inches, are the following:—

		Head and Body	Tail	Hind foot
Murree Hills, Kotli	yg. ad. ♂	23⅗	17⅕	5⅗
Gharial near Murree	ad. ♀	23	15	5⅕
Kandahar (Hutton)	ad. ♀	24	17	...

These data are too scanty to establish definite conclusions. They merely suggest that *grifithii* is on the average smaller than *montana*, sex for sex.

The first skull of *griffithii* in the table was collected by Swinhoe and is marked 'Scully', indicating that it is the one above referred to of which Scully published some measurements, namely the condylobasal length, the zygomatic width, the length of the mandible and the three teeth. My measurements agree very closely with his, except in the condylobasal length, which he entered as 139 mm. This was no doubt a misprint. At all events a skull of that length would have had a mandible exceeding 100 mm. The second Kandahar skull was presented by Blanford. The third was another of Swinhoe's. Their dimensions are inserted to show their general agreement with the skulls from the Murree Hills and Wazaristan. The second ad. ♂ skull from the Murree Hills belongs to the skin in the red phase collected by Aitcheson. It is smaller than the smallest of the ♂ skulls of *montana*.

An interesting point is the exceptional size of the teeth in the first skull. They are equal to the teeth of a considerably larger race of fox found in Western Turkestan, the Altai and near Lake Baikal, which I identify as *beringiana*, and are larger than in *montana*, although the teeth of the remaining six skulls of *griffithii* are on the average smaller than in *montana*.

CRANIAL AND DENTAL MEASUREMENTS OF THE LARGEST AND SMALLEST ♂ AND ♀ SKULLS OF *V. V. MONTANA* AND *GRIFFITHII* ARRANGED ACCORDING TO LOCALITY.

LOCALITY AND SEX	Cond. Bas. Length	Zygom. Width	Postorb. Width	Int. Orb. Width.	Max. Width	Upper Cheek Teeth	Mand. Length	pm^4	m^1	m_1
montana										
Sikhim, Kapup yg. ad. ♂	139	72	23	26	24	65	110	13	9½	15
,, Thana old ♀	131	73	23	27	22	62	102 +	12	9	14 +
Kumaon, Takula ad. ♂	141	76	21	27	22½	66	108	13	8½	15
,, ,, ad. ♂	129	74	21	27	22	60	100	12	9	13½
,, ,, ad. ♀	132	72	21	25	20	62	103	12	9	14
,, Almora ad. ♀	129	69	20	25	21	61	100	12	9	14
Simla, Dagshai ad. ♂	135	75	22½	26	23	64	104	12	10	16 –
,, Chakrata ad. ♀	132	74	23	26	23	61	100	12½	9½	14
Kangra old ♂	140	78	20	27	24	65	110	13	9	14
,, ad. ♂	134	75	23	28½	24	64	103	12	9	13
,, oldish. ♀	127	71	19	24	20	60	98	12	10	14
Chamba, Pukri ad. ♂	137	77	20	29	24	64	108	13 –	10 –	15
,, Bara Tissa ad. ♂	128	71	23	26	20	60	96	12	9	14
,, Chalan Tissa ad. ♀	130	74	20	27	22	60	101	12	9½	14½
,, Charan Tissa ad. ♀	123	69	24	23	19	56	93	12	9½	14
griffithii										
Kandahar ad. ? ♂	132	69	22	23	21½	62	100	14	10½	16
,, ad. ? ♂	127	65	17	23	19	59	94	12	9	14
,, ad. ? ♀	124	65	18	22	19 –	57	94	12 +	8	14
Wazaristan, Wano yg. ad. ♂	127	67	23	24	21	58	96	12	9½	14
Murree Hills, Kotli ad. ♂	127	72	22	26	21	59	99	12	9	14
,, ,, ad. ♂	125	72	22	25	21	60	90	12	9 –	14
,, ,, Gharial ad. ♀	125	72	20½	26	21	58	99	11	8½	13

Vulpes vulpes pusilla, Blyth.

Vulpes flavescens, Blyth, *Journ., As. Soc. Beng.,* vol. xxii, p. 581 (1853); Gray, *Proc. Zool. Soc.* p. 517 (1868), (not *flavescens* Gray, 1843).[1]

Vulpes pusillus, Blyth, *Journ., As. Soc. Beng.,* vol. xxiii, p. 729 (1854).

Vulpes leucopus, Blyth, *Journ., As. Soc. Beng.,* vol. xxiii, p. 729 (1854); and vol. xxv, p. 443 (1856); Blanford, *Mamm. Brit. Ind.,* p. 151 (1888), and of subsequent authors.

Vulpes persica, Blanford, *Ann. Mag. Nat. Hist.* (4), vol. xvi, p. 310 (1875); *Zool. of Eastern Persia,* p. 39, pl. 2 (1876).

Locality of the type of *pusilla,* the Salt Range; of *leucopus,* Moultan; of *persica,* Shiraz.

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[1] *Vulpes vulpes flavescens,* a name which figures in the bibliography of Indian foxes, is a fox from N. Persia as large as *montana* and related to it. It occurs in two colour phases, the typical 'flavescent' and the 'red'. The latter was named *splendens* by Thomas. That at least is my interpretation of *splendens.*

Distribution: Throughout the more or less desert districts of N.-W. India from Rawalpindi to Rajputana, Sind and Cutch and through Southern Baluchistan to Southern Persia and Mesopotamia.

Size very variable but considerably smaller, sex for sex, than *montana* and a little smaller than *griffithii;* general colouration very uniform, apart from seasonal changes, throughout the vast range of the race, never exhibiting the 'red' phase in the winter coat, not very different from some skins of the 'flavescent' type of *montana*, but much less black than the dark Kangra and Chamba skins of that race and never so silvered and hoary as in typical *griffithii* and with the ochreous or buffy hue of the dorsal side much more extensive. The seasonal changes in colour are very marked as described below in the case of the Salt Range skins; but, in addition, when the coloured contour hairs are first shed the tint of the back may be dark greyish brown.

In his first reference to this fox as *flavescens* from the Salt Range, Blyth described it as 'much brighter than Afghan skins, tints purer more contrasted, legs paler, redder, less black than *montana*'. A year later, when he named it *pusillus*, he said that it nearly resembles *montana* but is smaller. The name *pusillus* has line priority over *leucopus* and, according to the rules of nomenclature, should be preferred.

In his description of *leucopus* Blyth quoted Elphinstone's observation that the fox of the Western Hurriana desert is smaller than our fox (*montana*) and in one part of the desert has the legs and belly black, in another white. Blyth based his species *leucopus* on a specimen from Moultan which he described as smaller than *pusillus,* light fulvous on the head and back, variegated with black and white, the cheeks, sides of the neck, flanks the inside and mostly the front of the limbs being white. Two years later he referred to the same species specimens from Hansi and Hissar, from a spot between Indiana and Ferozepore and from Cutch. The specimen from Hansi had the belly black and the legs dark, showing Blyth the inappropriateness of the name *leucopus*.

The opinion expressed by Adams [*Proc. Zool. Soc.* (1858), p. 516] that *leucopus* would turn out to be the same as *pusillus* was adopted by Blanford, who unfortunately chose the inadmissible name *leucopus*, giving it full specific rank. Mivart [*Mon. Canidoe* (1890), p. 123] followed Blanford in this respect; but he was the first to detect that Blanford's *persicus* is a synonym of *leucopus*, although he quite failed to see the close kinship between *leucopus* and typical *Vulpes vulpes* and wrongly affiliated it with *V. corsac* of Central Asia, which is related to *bengalensis.* With far more material than other authors were able to examine, I have been unable to distinguish *leucopus* from *pusilla.* I have not, however, seen topotypes of *leucopus* from Moultan. But specimens from Hissar which Blyth referred to *leucopus* are inseparable from specimens from the Salt Range, the type-locality of *pusilla.* Nevertheless as the table of measurements shows, the skulls of Sind specimens appear smaller on the average than those from the Upper Punjab. I believe the differences to be merely individual. At all events the evidence that these small specimens represent *leucopus* is quite inconclusive and the intergradation is complete.

It is needless to attempt to describe in detail the very large number of skins, in the British Museum, which I assign to this race. A few will serve to illustrate the individual and seasonal differences.

Bhattu in Hissar, 6,000 ft. (Col. Stockley), November 12th. Two skins ♂, ♀ in new winter coat are tolerably uniformly rich ochreous, spangled with whitish above; flanks whitish; thighs externally and lower shoulders hoary, the contour hairs showing a white band with a black tip; tail ochreous above with black tipped hairs; fore leg dark, brownish to nearly black, with the toes paler; hind leg below hock white in front, with a dark spot on the paw; under side ashy grey, with the chin white.

Ara in the Salt Range, 2,300 ft. Two later skins (Wells), March 26th, ♀, resemble the skins from Hissar, but a ♂, March 23rd, is much less well coloured above the tint being apparently faded with the close of the winter. An adult ♂, ♀, 3,800 ft. (Stockley), July 27th, in summer coat, are very different. In the ♀ the moult is not quite complete, the ochreous-brown tint of the new hair of the back being partially obscured by old deep brown long hair, the new coat of the under side is white, but some old dusky hair is retained on the throat; the fore legs are tan, grizzled down the front; the hind legs are paler. In the ♂ the moult is completed, the colour above being ochreous brown, the flanks grey, the under side white as in the new coat of the ♀, but the feet are much darker.

Chakdulla, Campbellpore, 2,000 ft., in the Attock district of the Upper Punjab (Stockley). A young ad. ♀, November 17th, closely resembles the Hissar series, but is not so hoary on the shoulders and thighs and has the fore legs pale yellowish brown, the hind legs nearly the same and not strongly contrasted with the fore legs as in the Hissar skins. This skin and a ♀ from Potwar W. of Rawalpindi (Bingham), February, which is rather duller in hue, both from the extreme northern part of the range of *pusilla* in the Punjab, differ strikingly in colour from the skins identified as *griffithii* from higher altitudes in the Murrie Hills a few miles to the east and north-east.

Numerous skins from the following, amongst other localities, differ to a certain extent individually in the coloration of the upper and undersides and of the limbs and often considerably in accordance with the moult, but are indistinguishable as a whole from those above described from farther north.

Kashmor, Mirpur, Khairpur in Upper Sind, on the right and left banks of the Indus (Prater); Thar and Parker, Lower Sind; Bhuj and Nokania in Cutch (Crump); Jodhpur and Sambhar in Rajputana (Adams and Hume). Also a large number of skins collected by Sir J. E. B. Hotson at or near Khozdar and Turbat and Panjgur in Southern Baluchistan are indistinguishable from Indian skins; and the same is true of S. Persian skins, the type and topotypes of *persica* Bl. from Shiraz, one from Chahanbar on the Persian Gulf (Hotson), one from the Karun River, identified by Thomas as *flavescens* (see below), three from Baghdad (Cox and Cheesman) and one from Ctesiphon on the Tigris (Christy).

The following are the flesh measurements in English inches of the largest and smallest ♂ and ♀ examples from the principal districts arranged roughly geographically from north to south and westward:—

		Head and Body	Tail	Hind foot
Attock, Campbellpore ;	yg. ad. ♀	20⅘	15⅖	5⅗
Salt Range, Ava ;	ad. ♂	22⅖	15⅗	5
,, ,, ,,	ad. ♂	21⅕	14⅘	5⅕
,, ,, ,,	ad. ♀	21⅕	13⅗	5—
,, ,, ,,	ad. ♀	20⅖	14⅘	5⅖
Hissar, Bhattu	ad. ♂	21⅖	14	5⅖
,, ,,	ad. ♀	21⅘	14⅕	5⅖
,, ,,	ad. ♀	19⅕	13⅕	4⅘
Rajputana, Sambhar	ad. ♂	21¾	(11)	5
Upper Sind, Kashmor	ad. ♂	21⅗	15⅗	5⅕
,, ,, Mirpur	ad. ♀	20	12⅕	4⅖
Sind Tar, Parker	ad. ♀	19	12⅗	...
Cutch, Bhuj	ad. ♂	20⅖	13⅘	5⅕
,, Nokania	ad. ♀	19—	12⅗	4⅗
Baluchistan, Wadh	ad. ♂	22⅘	17⅗	5½
,, Mand	ad. ♂	22	16⅗	5⅗
,, Khozdar	ad. ♀	22	16⅗	5⅗
,, Panjgur	ad. ♀	20	15⅘	5⅕

The ear is only slightly smaller than in *montana*, a trifle under 3½ in. on the average.

Two flesh-measured ad. ♂ skins from S. Persia, one from Chahanbar (Hotson), the other from the Karun River, both localities being on the Persian Gulf, have the head and body 23 1/5 and 22 1/5 in. respectively; and three adult ♂ skins from Baghdad (Cox and Cheesman) are 21 1/5 in.

The only recorded weights in English lbs. are as follows:—Kashmor, Upper Sind., ad. ♂ 8 lbs.; Bhuj, Cutch, ad. ♂ 6¾ lbs.; Ara, Salt Range, 2 ♀ 5¼ and 4½ lbs.

The flesh dimensions show that this race is a little smaller on the average than *griffithii* and considerably smaller, sex for sex, than *montana*. The weights are also much less than in *montana*.

The skull measurements entered below show a complete overlap in size between *pusilla* and *griffithii*, but a decided inferiority on the average of *pusilla*. One interesting point emerges, namely the comparatively diminutive size of some of the foxes over a considerable area of Upper Sind. The physical conditions of the district must be less favourable to growth than elsewhere; and possibly these small foxes represent a distinct race, for which it might be thought the name *leucopus* was available. But Blyth's localities for *leucopus* were Ferozepore, Ludhiana, Hansi in Hissar, Moultan and Cutch and the foxes in the British Museum from Hissar, from Kashmor in Upper Sind, the nearest locality to Moultan, and from Cutch closely resemble examples from the Salt Range, whence the type of *pusilla* came. The desert foxes of Rajputana are also rather small, intermediate in size between those from the Salt Range and the smallest from Upper Sind.

CRANIAL AND DENTAL MEASUREMENTS OF THE LARGEST AND SMALLEST ♂ AND ♀ SKULLS OF BRITISH INDIAN EXAMPLES OF *V. V. PUSILLA* ARRANGED ACCORDING TO LOCALITY.

LOCALITY AND SEX	Cond. Bas. Length	Zygom. Width	Postorb. Width	Int. Orb. Width	Max. Width	Upper Cheek Teeth	Mand. Length	pm^4	m^1	m_1
Attock, Campbellpore yg ad. ♀	115	62	21	21	16½	53	87	11	9	12
Salt Range (Oldham) ad. ♂	127	69	17 +	24 +	21	60	96	12	8½	13
,, (M. Stuart) old. ♀	108	65	20	21	17½	53	84	10	8	12½
,, Ara (Stockley) ad. ♂	122	67	23	22	19	55	94	11	8	13
,, ,, ad. ♀	117	65	21	24	20	56	90	11½	9	13 +
Hissar, Bhattu ,, ad. ♂	124	65	18	23	19	57	96	11	9	13
,, ,, ,, ad. ♂	117	65	19	23	20	56	88	12	9	13
,, ,, ,, ad. ♀	114	61	19	19	18	52	87	11	8	12½
Upper Sind, Kashmor ad. ♂	122	69	20	21	20	58	94	12½	9	14
,, ,, Wahi Pandi ad. ♂	110	63	21	23	18	51	...	11	8	...
,, ,, Khairpur ad. ♂	108	60	19	21	18–	49	82	10	8 +	13
,, ,, Rohri ad. ♀?	105	61	22	20	17½	50	80	11	8	12½
,, ,, ,, ad. ♀?	102	59	19	20	17	48	71	10	8	12
Lower Sind, Umarkot ad. ♂	119	63	19	21 +	18	57	93½	11½	9	13
Cutch, Bhuj ad. ♂	120	65	19	22	18	52	90	10	8	11
Rajputana, Jodhpur ad. ♂	112	59	23	20	18	53	86	9½	8	12
,, Sambhar ad. ♂	117	68	21	24	18½	54	90	10½	8	12
,, ,, ad. ♀	111	61	23	20	18	52	85	11	8	12
Baluchistan, Mand ad. ♂	125	(64 ±)	...	25	20½	60	96	11	9	13
,, ,, ad. ♀	110	60	18½	21	17	54½	83	11	8	12 +
,, Wadh ad. ♂	115	65	20	22	17½	53	...	11 +	8	...
,, Khozdar ad. ♀	123	65	19	21	18½	56	...	11	8	...
,, Panjgur ad. ♀	113	...	23	20	18–	55	86	12	8½	13

Vulpes bengalensis, Shaw.

THE BENGAL FOX.

Canis bengalensis, Shaw, *Gen. Zool.,* vol. i, p. 330 (1800).
Canis kokree, Sykes, *Proc. Zool. Soc.,* p. 101 (1831).
Canis (*Vulpes*) *indicus*, Hodgson, *As. Res.,* vol. xviii, pt. 2, p. 237 (1833), (*nom. preocc.*).
Canis (*Vulpes*) *rufescens*, Gray in Hardwicke's *Illustr. Ind. Zool.,* pt. 2, pl. 3 (1833-4).
Canis chrysurus, Gray, *Charlesw. Mag. Nat. Hist.,* vol. i, p. 577 (1837).
Vulpes hodgsonii, Gray, *Charlesw. Mag. Nat. Hist.,* vol. i, p. 578 (1837).
Vulpes xanthura, Gray, *Proc. Zool. Soc.* (1837), p. 68 (published January 22, 1838; see *Proc. Zool. Soc.*, 1893, p. 437).
Vulpes bengalensis of all recent authors.

Locality of types of *bengalensis* (from Pennant), Bengal; of *kokree,* Deccan; of *indicus,* India; of *rufescens,* India; of *chrysurus*, *hodgsonii* and *xanthura,* Nepal.

Distribution: The whole of India from the foothills of the Himalayas, up to 4,500 ft. at Kangra, to Cape Comorin and from Sind to Eastern Bengal (Bihar and Orissa) and even to Assam according to Blanford.

Distinguished from *Vulpes vulpes* by the black tip of the tail, by the ears being the same tint as the nape or, when darker, never exhibiting the blackness characteristic of that species, by the presence of only two pairs of mammae instead of three, by the shorter, less luxuriant winter coat and the finer, closer pale speckling of the dorsal pelage. The size on the average is nearly the same as in *V. v. pusilla;* but the tail and hind foot are a trifle shorter. It is doubtful if there is any constant difference between the skulls of *V. bengalensis* and *V. v. pusilla.* They are frequently very difficult to distinguish; but the teeth of *bengalensis* are on the average smaller, the difference being more apparent to the eye than when expressed in millimetres, and the nasals are usually broader in their posterior part.

Notes on the synonymy: The fox described by Pennant as the 'Bengal Fox', which Shaw named *bengalensis,* was probably exported from Calcutta. Its locality may be fixed as the adjoining area of India, south of the Ganges. There was no precise locality for the type of *kokree* and no character to distinguish it from *bengalensis* was given. The type, ticketed the Deccan, is in the British Museum. Hodgson recorded *indicus* as occurring over the greater part of India. The type in the British Museum has no locality, but since the name was preoccupied for the Indian Jackal, the locality is of no moment. The next name *rufescens* similarly cannot be assigned to the fox of any definite locality. Hardwicke's illustration, which is the type, indicates a specimen which had moulted the black and white contour hairs and was tolerably uniformly fulvous. The names *chrysurus* and *xanthura* were given by Gray to the same specimen, a fox collected by Cobbe in Nepal. The type is in the British Museum, the skin labelled *chrysurus,* the skull *xanthura.* The type of *hodgsonii* also came from Nepal.

Colour of the dorsal surface very variable according to the condition of the pelage. When the coat is fresh and unfaded the dorsal surface and flanks are everywhere speckled with the whitish bands in the contour hairs, but the crown and the back behind the shoulders are brownish, ochreous or buff, owing to the summit of the wool and a small area between the black tip and the white band of the contour hairs being one of those tints; but these tints are absent on the flanks, which are greyish and speckled, and mostly on the nape which is typically thus contrasted with the back and crown; the muzzle is darkish but there is usually a greyish black smudge in front of the eye; the throat is white, the chin sometimes fuscous, and there is often a fuscous collar on the hind throat and a good deal of buff on the fore breast and axillae; the belly is white but the base of the tail below, the anal and genital areas and the backs of the thighs to the hocks are ochreous or rufous; the hind leg in front below the hock is whitish or some pale shade and the fore leg is rufous from the elbow externally, but greyish with a varying amount of black down the front usually to the wrist; the tail is mostly darkish grey owing to the black and white contour hairs which form a good brush, the black being dominant at the end to form the black tip. When the pelage is in moult or approaching it and the hairs are dead or dying the characteristic colouring described above fades away.

Although the large number of specimens collected by the Mammal Survey suggests that this species may be represented by a few local races, as might be expected from its wide distribution and varied environment, the insufficiency of series of skins collected at the same time of the year in different localities and the considerable individual variation in skins and skulls from the same locality make the definition of local races impossible for the present. If further material shows they can be established, *kokree* will come in for the Southern Deccan form, *chrysurus* for the Northern Nepalese form and *bengalensis* itself for the form from the central plains of India south of the Ganges.

Some individual and seasonal variations in the species may be shown by brief reference to a few of the skins collected for the Survey in the principal districts.

Bahgownie in Darbangha, 150 ft. Ten skins collected by Baptista between July 29th and October 21st. No two are quite alike in every respect, the extremes being collected on consecutive days, July 29 and 30. One, July 30, is a dark fox with the brown of the crown and back conspicuously speckled with black and buff, the flanks grey, speckled with black and white; the chin and throat white, a blackish collar on the hind throat, breast buffy, and abdomen whitish; inguinal region and back of thighs deep brown; hind leg below hock in front whitish, with the paw dusky; fore leg deep brown above externally, speckled black and grey down front. The other, July 29, is in poorer coat and much paler, with the contour hairs more scanty, so that the black and white speckling is much less in evidence; below the hind throat has hardly a trace of the collar, the breast is much paler buff; the inguinal area and the legs are rusty ochreous rather than brown and there is less pigmentation down the front of the fore leg. The remaining specimens are in varying degrees intermediate between these two.

Haldibari, just south of Sikhim (Crump), an adult ♀, April 13th, is moulting, the coat being thin on the body and tail and bleached so that the colour is a little paler than the palest skin from Darbangha; the belly is nearly naked in preparation for suckling.

Kangra. An adult ♀ collected by H. Whistler at Hamirpur, 2,000 ft., is undated, but evidently in winter coat, which is full, and soft and 37 mm. long; the general colour is very much as in the darkest of the skins from Darbangha. Another ♀ from the Kangra Valley (Wells), 2,000 ft., March 28th, has the same coat but is rather paler than Whistler's skin, with the black hair still less abundant, the collar smaller, the breast less richly buff, the inguinal region and back to the thighs paler ochreous and the fore leg with much less black down the front. A third ♀ from Gopalpur, 4,500 ft. (Wells) March 13th, is like the last in colour below and on the legs, but the coat is not so full as in either of the others, despite the greater altitude, and the colour of the back is yellower and less speckled with black and white.

Gwalior. A series collected by Ryley O'Brien at Binganj, October-November, consists of mostly darkish, rich coloured skins tolerably closely resembling the darkest skins from Kangra and Darbangha but with the coat, owing to the season, fuller and longer than in the latter.

Sind (S. H. Prater). An ad. ♂ from Gangra Mithi Tal, Thar Parkar, October 4th, agrees in colouration with the average of the series from Darbangha. An ad. ♂ and ♀ from Mirpur in Sukkur, March 26th and 27th, are in moult and faded, showing only a pale buffy wash on the fore quarters and a more ochreous tint on the rump, the flanks are pale grey or dirty white, and there is little speckling on the fore legs. The ♀ which was suckling has the abdomen covered with short red hair. A ♀ from Khot Diji in Khairpur, April 10th, although in better coat is a close match of the two Sukkur skins. Another ♀ from Gambat in Khairpur, April 15th, has hardly a trace of buff or ochreous above, merely a faint wash on the hind back but the dorsal surface and flanks are darker than in the other March and April skins from Sind owing to there being more black in the contour hairs.

Deccan. Dharwar, 2,500 ft. (Shortridge). An ad. ♀, January 8th, in good coat, about 30 mm. long, has an ochreous wash down the back, spangled with white but with no black tips to the contour hairs, so that the dorsal colouration is paler than usual; the ears, however, are exceptionally dark and more strongly contrasted with the head and nape than is normally the case; there is a small darkish collar on the hind throat and some ochreous on the breast. This specimen has the belly moulted for suckling, a condition which in more northern specimens occurs later, at the end of March or beginning of April. An ad. ♂ from the same locality, 1,900 ft., December 21st, is very like the ♀ but has some black speckling in the coat.

Kurnool (Baptista). An ad. ♂ from Diguvameta, April 25th, has a thin short faded coat of dead hair with no wool and a pale grey sepia wash, speckled with buff, on the back. An ad. ♀ from Malakondapenta, May 19th, also has a thin short coat with no wool, but a brownish wash on the back and the shoulders and nape speckled black and white.

High Wavy Mountain in Madura, near the borders of Travancore (S. H. Prater). Two, June 8th, are in faded, thin summer coat, showing no distinctive characters. They are worth recording as the most southern examples of the species procured by the Survey.

Flesh measurements in English inches of the largest and smallest ♂ and ♀ specimens, where known, from the principal districts, are as follows:—

		Head and Body	Tail	Hind foot
Darbangha	ad. ♂	21⅕	11⅗	5
,,	ad. ♂	20⅖	10⅘	...
,,	ad. ♀	20	10⅗	4½
Kumaon	ad. ♂	20⅖	11⅕	4⅘
,,	ad. ♂	19⅖	11⅕	4⅗
Kangra	ad. ♀	23⅗	11⅗	4⅕
Gwalior	ad. ♂	24⅕	12⅘	4⅗
,,	ad. ♂	21⅖	11⅘	4⅖
,,	ad. ♂	22⅗	13	4⅖
Sind, Thar Parkar	ad. ♀	19⅗	12⅘	...
,, Mirpur, Sukkur	ad. ♂	17¾	9¾	4
,, ,, ,,	ad. ♀	18⅗	11⅓	4⅖
,, Gambat, Khairpur	ad. ♀	19⅖	11⅖	4⅗
Deccan, Kurnool	ad. ♂	19⅗	12	4⅘
,, ,,	ad. ♀	20⅗	12	4⅘
,, Dharwar	ad. ♂	20⅕	12	4⅗
,, ,,	ad. ♀	20	14	4⅘

The average length of the ear is 3 in.

The weight is from about 6 to 8 lbs. in adult males.

The measurements are on the whole tolerably uniform throughout the range of the species, although the single measured specimen from Kangra and the specimens from Gwalior, of which only the largest and smallest males are entered, appear to be larger than those from other districts. But since this is not borne out by any superiority in the size of the skulls, I suspect it is due to the 'personal equation' of the collectors. The exceptionally small adult ♂ from Mirpur, in Sind, is referred to below under the skulls.

SKULL MEASUREMENTS OF THE LARGEST AND SMALLEST ADULT ♂ AND ♀ SPECIMENS, WHERE KNOWN, FROM EACH OF THE PRINCIPAL DISTRICTS.

LOCALITY AND SEX	Cond. Bas. Length	Zygom. Width	Postorb. Width	Int. Orb. Width	Max. Width	Upper Cheek Teeth	Mand. Length	pm^4	m^1	m_1
Nepal (*chrysurus* type) ad. ♂	(117±)	68	18	22	20	52	90	10	8½ × 10½	11½
,, ad. ?	110	63	22	21	21	49	...	9	8 × 10	...
Darbangha ad. ♂	117	68	20	23	19	51	91	9½	8 × 11	11
,, ad. ♂	116	69	21	24	20	53	89	9+	8 × 11	11
,, ad. ♀	110	65	20	21	17½	49	84	9	8 × 10½	11
,, ad. ♀	104	59	20	20	18	47	80	9	8 × 10	11
Kumaon ad. ♂	114	66	19	23	18½	52	90	10	8 × 11–	12–
,, ad. ♂	106	60	20	20	18	48–	80½	9	8 × 10	11
,, ad. ♀	109–	63	22	23	18	50	85	10–	8 × 11–	12
Kangra, Gopalpur old. ♀	111	64	20	21	17	50	87	9	7 × 9	10
,, Hamirpur old. ♀	108	62	20	19	19	48	82	10	8½ × 12	12
,, Valley old. ♀	103	57	21	19	17	46	76	9½	8 × 10	11–
Gwalior, Binganj ad. ♂	115	65	22	23	19	52	87	9	8 × 10	10½
,, ,, ad. ♂	108	62	20	20	17	50	82	9	7½ × 9½	11–
,, ,, ad. ♀	110	58	18	18	16	51	83	10	8 × 10	11
Sind, Thar Parkar ad. ♂	(111±)	64	21	22	18	50	84	9	8 × 9½	11
,, Mirpur, Sukkur ad. ♂	92	59	20	19	16	40	70	8	6 × 8½	10
,, ,, ,, ad. ♀	105	60	19	20	18	47	80	9	7 × 9	10
,, Gambat ad. ♀	102	57	18	18	15½	46	76	9	7 × 9	10
,, Kot Diji ad. ♀	100	56	19	18	15	46	76	9–	8 × 9½	10½
Deccan (*kokree* type) ad. ♀	103	53	20	19	16	46	79	9	7 × 9	10
,, Kurnool ad. ♂	110	61	20	20	17	52	85	10	8 × 10	10½
,, ,, ad. ♀	115	61½	19	20	17	...	89	10–	8½ × 10	11–
,, Palkonda Hills ad. ♀	108	57½	19	19	17	50	84	9½	8 × 10	10
,, Dharwar ad. ♂	(117±)	62	19	18	16½	50	86	9	8 × 10	11
,, ,, ad. ♀	107	61	19	19	16½	49	...	9	8 × 10	...

Two facts connected with this table stand out as particularly instructive instances of individual variation in the skulls of this fox. The first is the difference in the size of the teeth exhibited by the two ♀ skulls from Gopalpur and Hamirpur in Kangra. Both are old with the teeth about equally worn, yet the first upper molar (m^1) of the skull from Hamirpur, collected by Mr. H. Whistler, is wider than the same tooth in any other skull of the species I have seen. In the Gopalpur skull, on the contrary, that tooth is rather exceptionally small. Its lower carnassial (m_1) also is considerably smaller than in the skull from Hamirpur. In the third ♀ Kangra skull the teeth are about average in size and intermediate between the other two.

The second point is the exceptionally small size of the ad. ♂ skull from Mirpur, Sukkur in Sind. It is hardly longer in condylobasal length than Blanford's Fox (*V. cana*) from Baluchistan, although much more robust, and is much shorter than the ♀ skull from Mirpur collected at the same time by S. H. Prater. The ♂ skull must be regarded as that of a dwarf,[1] and the dwarfing has affected the upper carnassial (*pm^4*) and the first upper molar (*m^1*) as well. The other ♂ skull from Sind, from Thar Parkar, has an estimated condylobasal length of 111 mm. which is the same as the average of 5 ♂ skulls from Gwalior, and of 6 ♂ skulls from Kumaon, but the average of 4 ♂ skulls from Darbangha is 116 mm.

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[1] It will be remembered that some of the skulls of *V. vulpes pusilla* from Sind are exceptionally small.

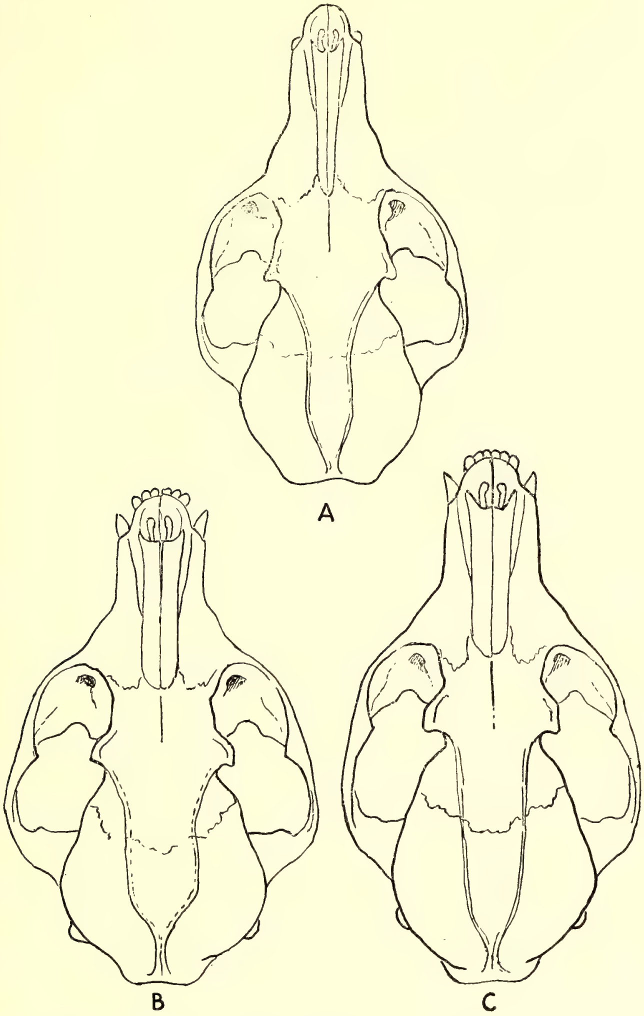

Fig. 2.—A. Skull of type of *Vulpes cana* from Gwadar.
B. Skull of dwarf ♂ of *Vulpes bengalensis* from Sukkur, Sind.
C. Skull of normal ♀ of *Vulpes bengalensis* from Sukkur, Sind.
All $\times\frac{1}{3}$.

Vulpes cana, Blanf.

Blanford's Fox.

'The Small Afghan Fox of Griffith', quoted but wrongly identified by Blyth, *Journ., As. Soc. Beng.*, vol. xiv, p. 344 (footnote) (1845).

Vulpes canus, Blanford, *Journ., As. Soc. Beng.*, vol. xlvi, pt. 2, p. 321 (1877); Sclater and Alston, *Proc. Zool. Soc.*, p. 392 (1878).

Vulpes cana, Blanford, *Mamm. Brit. Ind.*, p. 150 (1888); Ognev, *Ann. Mus. Nat. Hung.*, vol. xxiii, p. 238 (1926).
Vulpes cana var. *nigricans*, Shitkow, *Zool. Anz.*, vol. xxxii, p. 448 (1907).

Locality of the type of *cana*, Gwadar, Baluchistan; of *nigricans*, Bokhara in Turkestan.

Distribution: Baluchistan, Afghanistan, N.-E. Persia (Khorassan) and Turkestan.

Distinguished from *V. bengalensis* by its smaller size, much fuller, softer and more luxuriant winter coat and by its very different colouration; the coat when fresh exhibiting on the back none of the black and ochreous or buff or white close speckling characteristic of *bengalensis*. The contour hairs of the back, which vary from 45 to 65 mm. in length, have an extensive black tip and an extensive silvery subapical band; the thick wool, varying from 35 to 45 mm. in length, may be grey or lighter or darker ochreous at its summit; the muzzle is darkish, with a conspicuous black smudge in front of the eyes; the crown and cheeks to a varying extent silvery; the ears blackish grey; the flanks and under side are mostly white, but the chin may be blackish and there may be some infuscation on the hind throat and some buff on the breast; the tail is mostly grey, overcast with the extensive blackness of the tips of the contour hairs ranging from 65 to 90 mm. long and forming a voluminous black-tipped brush; the legs are mostly darkish grey, with some black, the ends of the digits are whitish, but sometimes the legs have no black and are mostly ochreous and cream.

There are four skins of this species in the British Museum. An ad. ♂ collected by Sir J. E. B. Hotson at Turbat, Kech, Baluchistan, on December 13th, has the summit of the wool of the back grey, with an ochreous wash in it on the nape; the legs are blackish grey; the forehead and cheeks silvery. Blanford's type taken 15 miles from Gwadar, near Kelat, Baluchistan, differs in having a faint ochreous wash down the back, which is more silvery, less overcast with black; the legs paler grey and the forehead and cheeks less silvered. A skin from Kandahar, Afghanistan, has a richer ochreous wash down the back than the type. A skin bought in Peshawar and said to have come from Bezaur, N.-W. F. P., is still more richly ochreous on the back than the Kandahar skin, and the legs are very pale, the fore leg being creamy grey down the front, ochreous behind and the hind leg ochreous above the hock, instead of grey, and in front below the hock cream (the paws are missing).

The specimen collected at Turbat is the only one of the series measured in the flesh:—head and body, 16 in.; tail, —;[1] hind foot, 4 in.; ear, 3½ in. It may be noted that the ear is almost as long as the hind foot and is actually as long and therefore relatively considerably longer than in *bengalensis*.

The skull has the general shape of that of *bengalensis* but is smaller and, judging from the two examined, is muscularly less well developed, the temporal ridges forming a wide lyriform area. The carnassial teeth also are relatively larger. As the measurements show these teeth (pm^4 and m_1) are as large as in the biggest skulls of *bengalensis* and actually larger than in the smallest dwarfed ♂ skull of this species from Mirpur in Sind. The first upper molar (m^1) is also a trifle larger than in that skull and very nearly if not quite the average size of other skulls. But a comparison between the general dimensions of the dwarf ♂ skull of *bengalensis* from Mirpur and the two of *cana* shows that although they are all of approximately the same condylobasal length, the *bengalensis* skull is more strongly developed, being broader across the zygomata and across the muzzle at the canines. A noticeable individual difference between the two skulls of *cana* is seen in the nasals which in the skull from Turbat are exceedingly narrow behind whereas in the type they are broader, although not so broad as in the average of *bengalensis*.

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[1] Hotson gave the tail as 135 mm. (=5 2/5 in.), but half of it is missing. In other made-up skins the tail is at least two-thirds the length of the head and body.

Vulpes ferrilata, Hodgson.

THE TIBETAN DESERT FOX.

Vulpes ferrilatus, Hodgson, *Journ., As. Soc. Bengal,* vol. xi, p. 278, pl. (1842); Blanford, *Mamm. Brit. Ind.*, p. 155 (1888); Bonhote, *Proc. Zool. Soc.*, p. 303, fig. (skull) (1905).

? *Canis ekloni,* Przjevalski, *Third Journ., Centr. Asia*, p. 193 (1883), (*nom. nud.*).[1]

? *Alopex eckloni,* Matschie in Filchner's *Exped. China and Tibet, Zool.*, p. 171 (1907).

Locality of type of *ferrilatus,* near Lhasa; of *eckloni,* Mongolia.
Distribution: Tibet, Nepal and the Upper Sutlej Valley.

Hodgson's skins from Nepal and a living example from that country exhibited in the Zoological Gardens, all referred to below, may have been brought to Nepal from Tibet. Stoliczka's record of the species from the Upper Sutlej (*Journ., As. Soc. Beng.,* xxxvii, pt. 2, p. 5) may be due to an erroneous identification of a specimen of *V. vulpes montana,* although it was associated with some typical Tibetan species.

Distinguished from the previously described species by its relatively much smaller ears, its shorter tail, its very thick but comparatively short and rather wavy winter coat and by several striking differences in the skull and teeth. Coat consisting of an intimate mixture of the contour hairs, which have a pallid subapical band, and the wool, the two being approximately equal in length and varying in length from about 25 to 40 mm., no doubt in accordance with the winter date; but interspersed in this coat, sometimes very sparsely, sometimes tolerably abundantly, are numbers of longer, fine black hairs up to 50 mm. or more in length. General colour above from the head on to the root of the tail ochreous from the tint of the tips of the contour hairs and the summit of the wool, speckled by the pallid areas of the contour hairs but hardly appreciably darkened by the long erect black hairs; the head often not so bright, greyer; the muzzle with no trace of a fuscous patch in front of the eye; the ears not sharply contrasted with the nape, but sometimes a little darker; a clear buff patch behind the ear. Sides of the neck, flanks and thighs hoary; tail dark grey, mixed black and white sometimes with a buffy tinge above; the tip extensively white; hind leg ochreous above the hock and down the back of the metatarsus; white in front below the hock; fore leg from the elbow ochreous, or palish buff with white paws and sometimes a fuscous patch on the wrist; upper lip, chin and the rest of the under side white, with the white of the hind throat set off on each side by a large fuscous patch.

This description is taken from six specimens in good coat, namely a recently received, mounted specimen from Tibet (R. Ward); two lectotypes from Lhasa (Hodgson), one from Eastern Central Tibet (Thorold) and two ticketed Nepal (Hodgson). Two younger skins, ticketed Nepal (Hodgson), are paler, either greyer or buffier than the rest, not so ochreous. But a skin from the Karo La Pass, 16,600 ft. is in full moult and differently coloured. Most of the contour hairs of the back are shed, those that remain having dead shrivelled tips; the wool is close and matted, about 25 mm.; the general colour is browner, not so ochreous and is conspicuously more blackened by the long black hairs; the tail has no contour hairs but is covered with soiled, felted wool.

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[1] This name was given by Przjevalski apparently to the Steppe Fox he identified as *Canis corsac* in 1875 in his *Mongolia and the Land of the Tongouts*. According to Delmar Morgan's translation of this work, vol. ii, p. 211, 1876, Przjevalski referred to this fox as occurring over the whole of Mongolia, Kansu, Kokonor and Tsaidan, being especially plentiful in the plains round Kokonor. But he secured no specimen and merely recorded what he knew of its habits; and no description was given when he altered the determination and named the fox *Canis eckloni.* I should not have quoted the name in this connection but for the reference to it as *Vulpes ferrilatus eckloni* by Ognev, who presumably took his opinion from Matschie's identification of *eckloni* and his comparison of it with *ferrilatus.* Matschie, however, assigned *eckloni* to the genus *Alopex* of which the type is *lagopus,* and *corsac* has a good deal of resemblance to *lagopus* in skull characters. On the other hand in the whole Vulpine series of species it would be impossible to find two with the skulls more different than *lagopus* and *ferrilata.*

None of the above described skins is dated or was measured in the flesh; but the following are the dimensions in English inches of the specimen mounted by Rowland Ward; head and body, 26½ in.; tail, 11¼ in.; hind foot, 5 in.; ear, 2 1/5 in. The ear of the skin from the Karo La Pass, when softened, was 3 mm. longer.

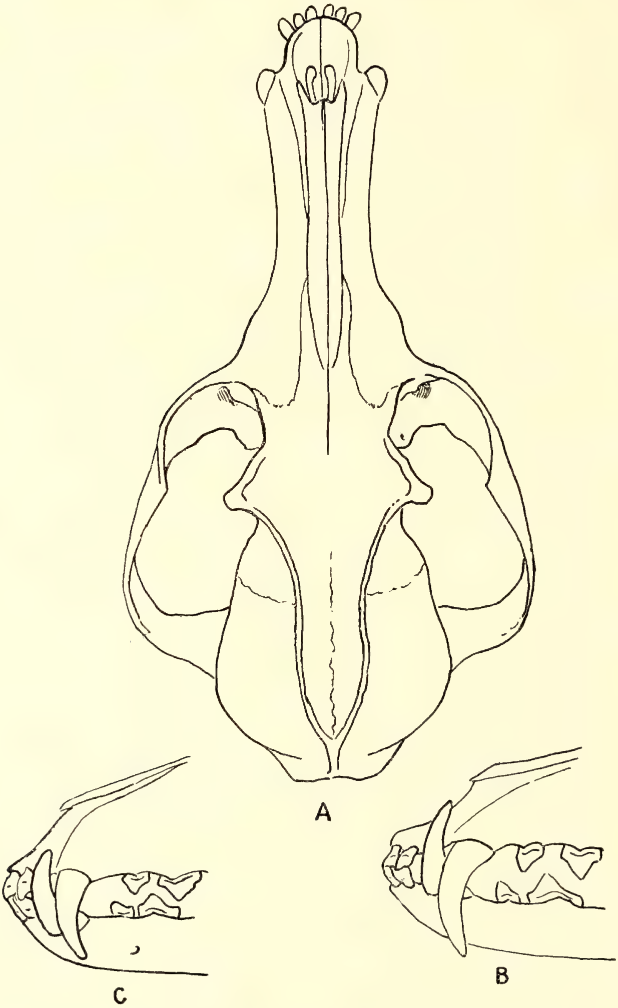

Fig. 3.—A. Skull of ad. ♂ of *Vulpes ferrilata* from Karo La Pass, Tibet.
B. Front end of jaws of the same from Gyang-tse, Tibet.
C. The same of *Vulpes vulpes montana* from Takula, Kumaon.

Incidentally these measurements disprove Blanford's statement that *V. ferrilatus* is considerably less in size than *V. vulpes montana;* but they show that the tail, without the hair, is less than half the length of the head and body, instead of over, and that the ear is about 1 in. or more lower. These differences also distinguish *V. ferrilata* from *V. bengalensis* and *V. cana.*

The very remarkable skull of this fox, which in its development is an extreme exaggeration of the Vulpine type, was unknown to Blanford and was first described by Bonhote who pointed out many of its peculiarities. The skull is longer in its condylobasal length, and in the length of the mandible and of the upper cheek-teeth than any of the skulls of *V. v. montana* I have seen; but the difference is due to the exceptional length of the jaws, the cranial portion, although it has rather wider zygomata, being actually shorter on the average. The jaws, however, are not only longer but narrower, being actually narrower by about 3 mm. above the second premolar than in a large skull of *montana,* but they expand above the canines where the width is about the same as in *montana.* The forehead is concave from side to side owing to the uplift of the postorbital processes. There are also differences in the teeth, the most noticeable being the extreme length of the canines in *ferrilata* in which the upper canine, when fully erupted and unworn, is 5 mm. longer down its anterior edge than the corresponding tooth in *montana.*[1] The lower canine is similarly higher and the upper premolars (pm^1 to pm^3) and the lower premolars (pm_1 to pm_4) are longer from back to front; but whereas the upper carnassial (pm^4) and the lower carnassial (m_1) are subequal to those of *montana,* the first upper molar (m^1) of *ferrilata* is smaller. From these differences it results that in *ferrilata* the height of the upper canine exceeds the combined lengths of the upper carnassial and the first molar, as set in the jaw, and that the third upper premolar is longer than the first molar. In *montana,* on the contrary, the canine is much less than the other two teeth and the third upper premolar is shorter than the first upper molar.

CRANIAL AND DENTAL MEASUREMENTS OF THE AVAILABLE SKULLS OF *VULPES CANA* AND *VULPES FERRILATA.*

NAME, LOCALITY AND SEX	Cond. Bas. Length	Zygom. Width	Postorb. Width	Int. Orb. Width	Max. Width	Upper Cheek Teeth	Mand. Length	pm^4	m^1	m_1
Vulpes cana										
Turbat, Baluchistan ad. ♂	91	50	19½	18	13	43½	69	10	7½ × 10	11
Gwadar ,, ad.	89	50½	18	19	13	41½	67	9½	6½ × 9	11
Vulpes ferrilata										
(Nepal) ad. ♂	152	86	24½	27	25	75	124	13	8½ × 12	16–
Tibet, Karo La Pass ad. ♂	145	83	26	24	23	75	118	13	8½ × 11	15
,, Gyangtse ad.	145	82	24–	24	25	70	116	13½	7½ × 12	15
,, E. Central yg. ad.	144	(72±)	22½	21	22	71	115	13	8 × 12	14½

Of the skulls of *ferrilata* entered on this list the first bracketed Nepal came from a living specimen presented by the Maharajah of Nepal to the present King Edward, when Prince of Wales. It has no skin and its locality is doubtful. The one from the Karo La Pass, collected by Col. Waddell, was figured and described by Bonhote. The one from Gyangtse, which has no skin, was received from Col. F. M. Bailey and the one from E. Central Tibet was presented by Mr. W. Thorold.

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[1] Bonhote recorded the canine of the skull from the Karo La Pass as 29 mm. and that of his type of *waddelli* as 20 mm. The latter is correct; but the former number is a misprint for 25.

THE SNAKES OF DEOLALI.

WITH NOTES ON THEIR COMPARATIVE OSTEOLOGY AND PECULIARITIES OF DENTITION.

BY

A. G. L. FRASER, I.M.D.

PART I.

(*With 2 plates and 2 text-figures*).

INTRODUCTION.

This paper is the outcome of a study, which in its initial stages had been restricted to identification, with a view to listing the families and species appearing from time to time in this locality. For this purpose a collection was begun in Deolali. When the limits to the numbers of the prevailing local species seemed to have been reached and no further fresh material was forthcoming, the study was amplified so as to include the more important features connected with the differences in the osteology and dentition of those members of the sub-order *Ophidia* met with in Deolali.

The work undertaken has occupied the greater part of the author's leisure period for a little over two years. The results have amply repaid the time and labour involved and the study itself has afforded much instruction and entertainment. It is thought that the data collected and now presented may serve some useful purpose by their publication; as the subject is one in which, but few are seriously interested. Further the existing literature available on the points of osteology and dentition is scarce—some of the publications having been long out of print—and hence so costly as to put them beyond the reach of many, who perhaps would become interested were they able to procure such books for reference. Again the necessity for surveys of this kind need hardly be emphasised, as they not only furnish a more intimate and permanent record, but add considerably to our knowledge of the distribution of the various species.

The subject has been approached from the view-point of an interested student and amateur field worker. By combining the study of such authoritative publications as have been available along with the first-hand information found in the field, the writer has endeavoured to gather as many practical data as possible about those animals.

For the better comprehension of the text of this paper, it was considered advisable to support it with many illustrations. No apology is necessary for their profuseness, as without these aids it would not be possible for the reader to readily follow and appreciate the morphological characters and more especially the divergent features existing and helping toward separating out the families, genera, and species. Great care has been exercised in the correct delineation of the peculiarities both in the case of the skulls and vertebrae, by enlarged scale drawings in black and white, featuring all the details in the original bones. These, again, have been photographically reproduced so as to make the final pictures look quite natural.

This paper will deal with a total 22 species belonging to four families, which have so far been investigated on the points of external characters. The osteology and dentition of 20 of these have been dealt with and will be found described in the notes which follow. For purposes of comparison 2 species extraneous to Deolali have been included in the total shown above. Of these, one is from Bengal and the other from Mahableshwar (Deccan). The latter one was imported into Deolali under peculiar circumstances and will be referred to again later.

A table has been compiled showing the cranial and vertebral column measurements of the species described. This table also shows the ratio of growth occurring in skeletons of specimens of varying length and ages. As regards the vertebral column, it has been found possible to group the snakes according to the differences noted in the formation of their vertebrae. This vertebral grouping is of great interest, and the table of variations depicts the natural series into which they fall.

The literature which has been studied will be fully quoted at the end of this paper, but special mention must be made of three valuable publications from which great help was derived:—(1) *A Catalogue of Snakes in the British Museum*, by Dr. G. A. Boulenger (1893-6), vols. i, ii and iii; (2) *The Thanatophidia of India*, by Col. F. Fayrer (1872); and (3) *Animaux venimeux et Venins*, by Mme M. Phisalix (1922), tome ii. The first of these was perused at the Bombay Natural History Society library rooms, Bombay, in an incomplete way during the brief respite of a few hours while on a short visit to that city. The two latter were made available for study through the kindness and courtesy of Mr. S. H. Prater, Curator of the Bombay Natural History Society, to whom the author is indebted for the privilege. The book *How to identify the Snakes of India*, by Col. F. Wall, C.M.G., I.M.S., has been found particularly useful and a very excellent practical guide to the identifications of snakes from their scale formation. The synopses and keys furnished therein are reliable aids to students, especially for those who have not the time for the labour involved in reducing to skeletons the specimens they wish to differentiate in a complete way.

GEOGRAPHICAL LOCATION, METEOROLOGY AND PHYSICAL FEATURES OF THE STATION.

Devlali or Deolali, the latter name is more popularly used, is a small Military Cantonment in the Nasik Civil Collectorate of the Bombay Presidency.

The height above the mean sea level is from 1,800 to 2,300 ft. The average rainfall is 30 in. The monsoon months are June, July, August and part of September. The hottest months of the year are March, April and May, with the maximum shade temperature fluctuating between 100 and 110°F. The coldest months are December and January, when the minimum shade readings vary between 44 and 60°F.; the average mean being about 85°F. Dry and Wet bulb registrations show a marked humidity during October.

The topography of the country in the environs is undulating in character. On the south side lie the Thal Ghat extensions running east and west. The land is for the most part under cultivation, and is intersected by deep tributary 'Nallahs' draining into the river 'Darna', which meanders through east of the Cantonment in a north-easterly direction to a point some ten miles east of Nasik City, where at 'Darna Sangava' it joins the sacred river Godaveri.

In order to obtain precise data as to the Ophidia present, 195 specimens collected over a period from December 1932 to January 1935 were examined and revealed evidence of 4 families and 20 species in an area roughly comprised within a 5-mile radius from Devlali Railway Station (G. I. P. R.). In this area lie the villages of Bagoor, Wadner, Nanegaon, Vehitgaon, Sansari, Deolali, Shigwa and the Nasik Road sector.

Included in the previously quoted figures is a collection of 45 snakes kindly sent to me by Mr. Fenton-Bailie, House-Master, Barnes High School, Deolali. His collection contained of the known poisonous groups fatal to man, 2 Cobras, with several young ones, 4 Kraits, 5 Saw-scaled Vipers (*Phoorsa*), and 1 Russell's Viper. All of his specimens were gathered in over a period of several years in the precincts of the Barnes High School, which is within the area specified.

A second collection belonging to Rai Sahib A. G. Gokhale of the Government Distillery, Nasik Road, who very kindly accorded me facilities for viewing it, contained 1 additional species labelled *Polyodontophis collaris*. There was neither time nor opportunity for closely examining the basic characters of this specimen. The particular label affixed to it is at variance with the habitat cited by authoritative writers on the subject, who show the distribution as Himalayas, Bengal, Assam (Wall, F., 1923)[1]; Himalayas and Assam (Phisalix, M., 1922).[2] Rai Sahib Gokhale is himself uncertain as to its identity. The colour markings correspond with those of *Polyodontophis subpunctatus* and 1 specimen of this species had already been secured in Deolali. As the specimen had been in spirit apparently for a very long time, no reliance could be placed on the colour. This collection however is excluded from the numbers personally examined, and it is mentioned only to show that, with one doubtful exception, it agrees with the findings at Deolali.

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[1] *How to Identify the Snakes of India*, by Col. F. Wall, C.M.G., I.M.S., 1923.

[2] *Animaux venimeux et Venins*, by Mme. M. Phisalix, 1922, tome ii.

The listed series tabulated in this paper can be considered as fairly representative of the types met with in the area, but of course cannot be so comprehensively complete as to include the whole of the Nasik Civil Collectorate. The hilly tracts of the district possibly do harbour other species. If the Deolali findings are compared with those ascertained by Col. Gharpurey, I.M.S.,[1] to be in Ahmednagar, in the adjacent Collectorate, the list for that area shows 1 added species, namely, *Eryx johnii*, whereas *Polyodontophis subpunctatus* and *Dryophis mycterizans*, which are rare snakes here have not been encountered by Col. Gharpurey. Except for these differences the two lists are identical.

General Morphological Features.

As a preliminary to the systematic description of each snake, it is necessary for our purpose, to give a brief synopsis of the general Ophidian characters as also the peculiarities which help to separate out the families and species, terrestrial, arboreal and aquatic; and so serve for their identification and classification.

A. *Common Characters.*

(1) The endoskeleton is encased in a scaled exoskeleton, which is devoid of any appendicular parts.

(2) The bodies are all elongated, but vary in shape and size.
   - (*a*) They may be of uniform rounded thickness throughout, built stoutly or slenderly without any delineation between the head and body or tail.
   - (*b*) A slender neck demarcating the divisions between the head and body, both of which may be lightly built or massively formed.
   - (*c*) Small heads connected by slim necks to bodies anteriorly thin, but posteriorly broadly built and equipped with flattened tails to facilitate progression through water.

(3) Tails of various kinds:—
   - (*a*) Rounded, much abbreviated, dumpy and stout or thinning out abruptly.
   - (*b*) Slightly compressed, much attenuated and fine (whip-like).
   - (*c*) Flattened dorso-ventrally and adapted to act as paddles.
   - (*d*) Equipped with rattles.

(4) Heads may be rounded, flat, ovate or triangular with or without loreal pits and horns.

(5) Muzzles acutely pointed, obtuse or squared.

(6) Nares placed laterally or superiorly behind the rostral (snout shield).

(7) Eyes covered with the antocular membrane, but lidless. Pupils, spherical or elliptical spindles placed in the vertical or horizontal positions.

(8) No external evidence of an auditory apparatus and no tympanic cavity.

(9) Tongue bifid and contractile.

(10) The flexibility and extensibility of the ribs, which in conjunction with the transverse plates or ventrals of the belly secure mobility and locomotion.

(11) The generative organ in the males is paired.

(12) The *Ophidia* are either oviparous, laying soft ovate eggs ordinarily hatched by the heat of the sun, or the warmth generated by fermentative processes set up in decaying vegetation; or ovo-viviparous, that is the eggs are incubated within the body and the young emerge alive and fitted for an independent existence.

(13) The red blood corpuscles are nucleated biconcave discs.

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[1] 'Snakes in Ahmednagar', by Lt.-Col. K. G. Gharpurey, I.M.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 1, p. 272 (15th November, 1932).

B. Classification.

There are about 1,700 species of snakes in the world (Manson, 1921).[1] Their identification and classification into 9 main family groups and their further separation into sub-family divisions, genera and species is based upon a study of:—

(1) (*a*) Head shields or scutae. Their presence and arrangement or their absence.
(*b*) Loreal pits and horns on the head or their absence.
(2) The costal scales:—Their size, shape, arrangement and number.
(3) The ventral plates:—Their size, width and number; or their absence.
(4) Anal shield, whether entire, divided into two or further subdivided into three sections.
(5) Subcaudal plates, whether entire or divided throughout or only partially so.
(6) Mental sublingual shields, whether present in one pair alone, or in two or three pairs.
(7) Tails, whether rounded, slightly compressed or flattened dorso-ventrally.
(8) Colour. This is not an accurate guide as there are variations even in the same species.
(9) Design. The pattern of the markings are a more constant feature in the adults, but the young of certain species differ markedly from the adult.
(10) Rudimentary limbs. Concealed vestiges of hind limbs below and near to the cloaca, peculiar to the sub-family *Pythoninae.*

The foregoing are the external characters. Their accuracy is considered of questionable value in distinguishing species, because of the aberrant types frequently met with. The more important fundamental differentiations rest upon the formation of the skull; the shape, size and position of the maxilla; the absence or presence of certain bones in the skull and chiefly the peculiarities of the dentition, which most of all facilitate the separation of the *Thanatophidia* or poisonous snakes. The known poisonous species belong to either of two families, namely, *Colubridae* and *Viperidae.* These are recognised by the size, length and position of the maxilla, which in the former is long, thin and horizontally positioned and in the latter short, thick and obliquely set.

The world *Colubridae* number some 1,300 (Manson, 1921),[1] and form the largest family of the sub-order Ophidia. They are divisible into three groups according to the peculiarities of their dentition. The presence of large infolding canaliculated recurved fangs placed in the forward position attached to the maxilla, denote the class known as the *Proteroglypha* (front-fanged). If situated posteriorly as the last in the maxilla series of teeth and grooved on their anterior aspect as well as recurved, they belong to *Opisthoglypha* (back-fanged). The third group comprises species in which the teeth are all solid and which are classed as *Aglypha.* There are further distinctions in the sub-families *Elapinae* and *Hydrophinae*, and the species in these sub-divisions are distinguished by the nature and setting of the teeth in the various situations in the roof of the mouth and the mandibles.

The poison fangs proper attain formidable proportions in some of the *Thanatophidia* and are connected by ducts to specialised poison glands in the *Proteroglypha* and the *Viperidae.* In the latter the poison fangs are comparatively larger and better developed and attached to a vertically fixed maxilla. The poison of certain species in the first 2 families cited above, if injected in lethal doses, has been established as dangerous and fatal to man and the higher animals.

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[1] *Manson's Tropical Diseases,* edited by P. H. Manson-Bahr, 1921, p. 874.

The *Opisthoglypha* possess a parotid gland, which secretes a toxin not definitely ascertained or known to be potentially fatal to the higher vertebrates. The *Aglypha* have solid teeth and homologous glandular structures secreting a venom, which, as in the *Opisthoglypha*, kills small mammals, birds, reptilia and amphibia.

The dentition in the case of the seven remaining families, namely, *Typhlopidae*, *Glauconiidae*, *Uropeltidae*, *Ilysiidae*, *Xenopeltidae*, *Boidae* and *Amblycephalidae* shows in some the presence of teeth in the premaxilla (intermaxillary), or the provision of a lesser number of teeth, or the absence of them in certain situations. All of the teeth in these are solid. These snakes do not assume the importance attached to those in the higher specialised categories mentioned, as they are believed to be innocuous; because the majority of them are possessed of small glandular structures in proportionately small heads and being devoid of grooved fangs can neither secrete enough venom nor inject it in a quantity great enough to act in a lethal way in man. There is actually no rigid division between the known poisonous snakes and other species. It can be accepted in a general way that all snakes are provided with some form of poison apparatus, variously graded and adapted to suit their needs for securing prey or for defensive or digestive purposes. The lethal and toxic effects of the venom from a number of species have been amply demonstrated in the laboratory by many investigators.

The *Viperidae* in the world number about 110 species (Manson, 1921)[1] and are divided into two sub-family groups, the *Viperinae* and the *Crotalinae.* The latter constitute the class which show a sensory uveal pit situated between the eye and the nostril. All of these are potentially venomous and certain species are known to be dangerous.

There are about 330 recognised species of snakes in India and Ceylon (F. Wall, 1928),[2] including the *Hydrophinae* or marine snakes characterised by their paddle-like tails. These number 29 species found in the Indian seas. They are all poisonous and the venom has been variously estimated by laboratory procedure to be of a higher potency than any of the terrestrial *Thanatophidia*, which number 39 (F. Wall, 1928).[2] As has been previously stated, these belong to either of the two families *Colubridae* and *Viperidae.* In Deolali 4 families and 20 species are represented; and it will be noted that some of the well known poisonous Indian species occur in the area.

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[1] *Manson's Tropical Diseases*, edited by P. H. Manson-Bahr, 1921, p. 874.

[2] *The Poisonous Terrestrial Snakes of our British Indian Dominions* (including Ceylon) *etc.*, by Col. F. Wall, I.M.S., K.H.S., C.M.Z.S., 1928, p. 5.

TABLE I.—LIST OF SNAKES FOUND IN DEOLALI

Family	Sub-Family	Species	Number examined		
			Mr. Fenton-Bailie's Collection		Total
Typhlopidæ		*Typhlops braminus* (Daud) Worm Snake	9	1	10
Boidæ	Pythoninæ	*Python molurus* (Linn.) Rock Snake...	2	...	2
Do.	Boinæ	*Eryx conicus* (Schn.) Red Earth Boa ...	9	1	10
Colubridæ (*Aglypha*)	Colubrinæ	*Nerodia piscator* (Schn.) Checquered Water Snake	9	2	11
Do.	Do.	*Rhabdophis stolatus* (Linn.) Buff striped Keel-back ...	2	2	4
Do.	Do.	*Polyodontophis subpunctatus* (Dum and Dibr.) Jerdon's Polyodont ...	1	...	1
Do.	Do.	*Macropisthodon plumbicolor* (Cantor) Green Keel-back or grass Snake	30	5	35
Do.	Do.	*Lycodon aulicus* (Linn.) Wolf Snake...	14	5	19
Do.	Do.	*Ptyas mucosus* (Linn.) Rat Snake ...	18	...	18
Do.	Do.	*Zamenis fasciolatus* (Shaw) Fasciolated Rat Snake ...	2	...	2
Do.	Do.	*Coluber helena* (Daud.) The Trinket Snake ...	3	1	4
Do.	Do.	*Oligodon arnensis* (Shaw.) The banded Kukri Snake	5	4	9
Do.	Do.	*Oligodon tæniolatus* (Jerd.) Variegated Kukri Snake.	6	5	11
(*Opisthoglypha*).	Dipsadinæ	*Dipsadomorphus trigonatus* (Schn.) The brown tree or cat Snake.	16	6	22
Do.	Do.	*Dryophis mycterizans* (Linn.) The green whip Snake ...	...	1	1
(*Proteroglypha*).	Elapinæ	*Bungarus cæruleus* (Schn.) The Common Krait ...	5	4	9
Do.	Do.	*Naia naia*, var *cæca* (Merr.) The Cobra ...	14	2	16
Do.	Do.	*Callophis trimaculatus* (Daud.) The Slender Coral Snake ...	3	...	3
Viperidæ	Viperidæ	*Vipera russelli* (Shaw.) Russell's Viper ...	1	1	2
Do.	Do.	*Echis carinata* (Schn.) The Saw Scaled Viper...	1	5	6
	SPECIES EXTRANEOUS TO DEOLALI				
Colubridæ (*Aglypha*)	Colubrinæ	*Polyodontophis collaris* (Bengal) ...	1	...	1
(*Opisthoglypha*).	Dipsadinæ	*Dipsadomorphus beddomei* (W. Ghats, Matheran) ...	1	...	1
		Total ...	152	45	197

Seasonal Appearance and Proportion of the Sexes.

The table on page 66 shows the numbers and species appearing during the period under survey by months. Of the number shown, 112 were dissected for the purpose of study connected with the organs, viscera, genital organs, bones, etc. The figures relative to the proportion of the sexes, as also the number of gravid females found have been included in the table.

As regards the proportion of the sexes, it will be seen in this table, compiled from notes carefully maintained throughout the period, that there is an extraordinary disparity recorded as between males and females. Thus taking the total figure of 112, the percentage for the males works out at 5·4 and the females 94·6; showing a ratio of roughly 1 male to every 17 females. It is, of course, much too early yet to form any opinion or draw any conclusion on these results, as much more data of a similar kind confirmatory of this apparent sex disproportion will be required before the position can be accepted as a true index. It would not be premature though if one were to analyse these figures by way of ascertaining the extent to which the known facts relative to the habits of these creatures fit in with the ratio of the sexes as now outlined in the table.

In an article which appeared in a previous issue of this *Journal*, Mr. Prater (April 1933)[1] reviews, on the sum total of the collected data available at present, the position connected with the association of the sexes. He quotes the many instances of partnerships between males and females limited to a period which he calls the breeding season. Owing to the insufficiency of the existing evidence this breeding season cannot be defined clearly for any one species. In certain cases the companionship was continued after actual union had taken place and was even extended till the deposition of the eggs or young. Converse proof as well is cited and emphasised, that in all the instances of the many solitary females discovered near to or upon their eggs, only in two cases, a King Cobra and a Python, was the male observed in the close vicinity.

In the survey at Deolali there was only one instance of an association, which must have temporarily existed for the purpose of sexual union, in the case of *Zamenis fasciolatus*. A gravid female was killed in a garage at about 6 p.m. on 17th January, 1935. Exactly a week later during the evening in the same garage a second snake was seen to emerge from a hole in the wall and was later killed. It proved to be a male of this species.

All the gravid females including the above-quoted specimen showed the eggs in an early state of development, having soft oval membranous envelopes containing only a creamy fluid. These pregnant females—8 in number, and belonging to various species—were recovered as will be noted at different times of the survey periods. The months in which they appeared fall into two

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[1] 'The Social Life of Snakes', by S. H. Prater, M.L.C., C.M.Z.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 2, p. 469 (15th April, 1933).

TABLE II.—SEASONAL INCIDENCE AND PROPORTION OF THE SEXES

Species	January	February	March	April	May	June	July	August	September	October	November	December	Total	Sex		Gravid Female	Remarks
														Male	Female		
Typhlops braminus ...	...	...	...	...	1	5	1	...	...	1 y	...	1	9	...	...	...	y :—Very young specimens 3″-6″ long.
Python molurus ...	1	...	...	...	...	...	...	...	...	...	...	1	2	...	...	...	
Eryx conicus ...	...	...	2 y	1	2	2	2 y	...	...	...	...	...	9	...	6	...	y :—Total—2.
Nerodia piscator ...	2 ♀	...	...	1	...	2	...	3	1	...	...	...	9	...	8	2 ♀	
Rhabdophis stolatus ...	...	...	...	...	...	1	1	...	...	...	...	...	2	...	2	...	
Polyodontophis subpunctatus. ...	...	1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	
Macropisthodon plumbicolor.	5 ♀	2	...	2 y♂	5 y	7 y	2 ♂	2	...	2	...	3 ♀	30	2 ♂	24	2 ♀	y :—2 in May, Total :—4.
Lycodon aulicus ...	2	1	...	...	2	3	2 y	2	1	...	..	1	14	...	12	...	y :—Total—1.
Ptyas mucosus ...	...	1	1	...	5	5 ♀	3	1	...	1	...	1	18	...	15	1 ♀	
Zamenis fasciolatus ...	2 ♀♂	...	...	...	...	...	...	...	...	...	...	...	2	1 ♂	1	1 ♀	
Coluber helena ...	...	...	...	...	...	2 ♀	...	...	1	...	...	...	3	...	2	1 ♀	
Oligodon arnensis ...	...	...	...	...	3	...	2	...	...	...	...	...	5	...	2	...	
O. tæniolatus ...	...	...	...	...	1	2 y	3 y	...	...	...	...	...	6	...	3	...	y :—Total—2.
Dipsadomorphus trigonatus...	1	...	...	...	5	3 ♂	4 ♀	...	1	1 y	...	1 ♂	16	2 ♂	12	1 ♀	y :—Total—1.
Dryophis mycterizans ...	...	1	...	...	...	...	...	...	...	...	...	...	1	...	1	...	
Bungarus cæruleus ...	1	...	...	...	...	...	1	...	1	2	...	...	5	...	3	...	
Naia tripudians ...	1	...	1	...	1	4 ♂	3 y	...	2	1	...	1	14	1 ♂	11	...	y :—Total—1, 7″ long.
Callophis trimaculatus ...	...	1	1	...	...	...	1	...	...	...	...	...	3	...	2	...	
Vipera russelli ...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	1	...	
Echis carinata ...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	
Total ...	16	7	6	4	25	36	25	8	7	8	...	9	151	6	106	8	

separate periods, December-January and June and July. Whether these two periods can be considered and defined as regular breeding seasons is very difficult to decide at the moment. The finding in two species of the young 2 to 5 months subsequent to the months during which the gravid females were encountered is consistent and would roughly indicate the interval necessary for the fertilisation, deposition and incubation of the eggs.

In the analogous examples of pairing during the breeding season amongst the Passerine birds and certain animals, one finds the sexes more or less equally distributed at least in a proportion, which would allow of the majority finding mates and forming a monogamous partnership in the sense of a seasonal continuity somewhat extended to cover sexual union, deposition of the eggs, incubation and care of the young until fledged, as is the case with many species. This form of companionship is well exemplified amongst the groups in which parental care is a paramount development and its exercise essential for the well-being and survival of the young. In the case of the snakes, however, we find an absence of parental anxiety—such indications as there are point to a scant attention paid to the eggs alone, rather than toward the young, which significantly enough emerge from the egg in a state perfectly fitted for an independent existence. Coupled with this is the evidence, that these creatures appear to lead isolated lives, in that they are normally seldom encountered in pairs. Environmental factors such as an extreme temperature in the very cold parts of the world operate in driving them into the gregarious congregations composed of the small hibernating groups in which they have sometimes been found.

The question now arises as to what are the justifications for postulating that the disproportion in the sexes supports and explains the observed habits and behaviour. A study of the detailed figures in the table shows that in certain species the number of egg-bound females recovered equals the number of the males found separately at the same time. Further, in all the species involved there is a variation in the sex proportion. The ratio in these is as under.

Species	Males	Females	Males	Females
Macropisthodon plumbicolor ...	2	24	1	12
Zamenis fasciolatus	1	1	1	1
Dipsadomorphus trigonatus ...	2	12	1	6
Nāia tripudians	1	11	1	11
			4	30
		or approximately ...	1	7 or 8

This average ratio of 1:8 may probably represent in a general way the actual relative proportion existing between the sexes of the above species. Both this ratio and the equal number of males and gravid females simultaneously discovered during the two periods apparent in Table II would explain:—(1) Why they are not more frequently observed in pairs. (2) That the variations in their behaviour connected with the partnerships affected, which appear in some to be of a temporary nature confined to the period incidental to insemination and in others somewhat more extended until the deposition of the eggs or young, would suggest that environmental conditions (*a*) in the former, militate against a long association in areas more controlled and inhabited by man, wherein certain species find the food and other values more conducive and beneficial in the struggle for existence; (*b*) in the latter, allowing of the development of a form of parental care confined to the eggs, peculiar to the larger species like the Python and King Cobra, which occupy lone wastes and jungle tracts more free from human intrusion and interference or other detrimental factors. (3) That an excess of females would balance the scales in favour of both the propagation and survival of the species in situations where unfavourable conditions especially attributable to human enmity produce a high death rate amongst them. (4) That amongst the dominant species in any one locality the females would normally show an increasing geometrical ratio; this position would also account for the fact that they are more often seen singly.

A further study of the figures in the table shows two phases of numerical increase. The first occurring during the months of May, June and July, when the greatest numbers were recovered. May is the hottest month of the year in Deolali and the monsoon is ushered in about the first or second week in June, becoming well established thereafter and during July. The figures for these months are really a measure point or mode, which would probably also indicate the factorial values of the environment, wherein at this season the conditions are best suited to the animal, namely, (1) temperature, (2) luxuriant vegetation and tall grasses affording easy surface concealment, (3) a plentiful food supply, (4) comparatively less human interference owing to the heavy rains. Paradoxically enough the figures for these months actually feature the highest mortality incidence. A death rate in any colony of animals is considered to be selective in action with a view to the elimination of the unfits. The greatest check to increases in the snake population is the hand of man. The mortality rate here shown was practically confined to those, who most exhibited an adventurous spirit, by prematurely emerging from their hiding places, either at too early an hour in the evening, or persisted in remaining exposed and visible during the early morning and forenoon, and in a few isolated instances even during the afternoons of a cloudy day. In fact this diurnal activity of a purely nocturnal animal is mainly responsible for 90 per cent of the death rate in the total number recovered throughout the period. Sunless monsoon days and a living food supply plentifully available at this season acted as the lure drawing them unwittingly to the gamble with their lives as the stake. The adage 'Be as wise as the serpent, etc.' here appears worn into a platitude. It should reasonably read: 'Even the wise serpent has much to learn'. The second phase of numerical increase though to a much lesser and negligible extent occurred in December and January. Both these periods correspond with the seasons during which the gravid females were encountered. Furthermore it is singular to note that the appearance of the males synchronised with the periods, with, but a single exception, during April, in the case of *Macropisthodon plumbicolor*. This species happens to be the dominant type in Deolali.

There is therefore some reason for believing that the sex disparity noted is probably the true position, as it tends to support and explain the relations and pertinent behaviour of these reptiles.

The consideration arises in the case of snakes as to what actually constitutes a breeding season. As has been shown the data hitherto collected are very indefinite and insufficient to allow of any definable limits being assigned. The term breeding season as used in the case of birds is known to be a definite period recurring in a regular annual cycle, sometimes in certain species twice yearly. It is said to be aroused as a result of some external or rhythmic stimulus (H. Whistler, 1932).[1] If this principle be applied to the *Ophidia* then normally we would expect to find them more constantly and frequently in pairs. We have seen that the evidence on this point is very meagre. The findings at Deolali are similarly inconclusive in that only one example of an association of the sexes can be reasonably presumed to have existed—that is only one case of pairing in a total of 151 snakes. Mr. Prater (April 1933)[2] observes:—'The finding of a male snake with a gravid female does not imply that the male so discovered is the one responsible for the gravid condition of the female'. In the instance quoted above the pair belonging to the species *Zamenis fasciolatus* were the only two of this kind met with in the two years of observation at Deolali and localised to one particular spot in a garage. So that the presumption that the male was responsible for the gravid female and must have been in a direct association is fairly valid and logical. The finding on the other hand of egg-bound females without the male makes the position somewhat difficult especially in the matter of defining the limits of a breeding season. The figures for Deolali shown in the table suggest two such periods provided the recovery of unpaired egg-bound females and unpaired males belonging to the same species be the basis for such definition. When, however, the Deolali figures as to the gravid females are compared with those of Mr. Lindberg (February 1932)[3] covering a similar range of species in the Barsi Light Railway sector, a variation in the species *Macropisthodon plumbicolor* becomes evident, in that gravid females were recovered during December and January at Deolali and March, April and May in the Barsi Light Railway area. That they were absent in Deolali during the months they were met with in the other area does not preclude the possibility of such being found at some future time in the reversed positions in both localities—not only in this species, but as a common constant feature in other species as well. Nor can it be said that the seasonal variability in their appearance is attributable to the meteorological conditions varying in the different geographical settings.

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[1] 'The Study of Indian Birds', by H. Whistler, F.Z.S., M.B.O.U., Part IX, *Journ., Bombay Nat. Hist. Soc.,* vol. xxxv, No. 3 (15th February, 1932).

[2] 'The Social Life of Snakes', by S. H. Prater, M.L.C., C.M.Z.S., *Journ., Bombay Nat. Hist. Soc.,* vol. xxxvi, No. 2, p. 473 (15th April, 1933).

[3] 'Snakes on the Barsi Light Railway (Deccan)', by K. Lindberg, *Journ., Bombay Nat. Hist. Soc.,* vol. xxxv, No. 3, p. 690 (15th February, 1932).

The conjoint results nevertheless demonstrate well enough the small amount of evidence forthcoming despite the two years' observations in both places. This question of the breeding season and the apparent variable character of the periods amongst the different species, requires concentrated and extended observations covering many years, in as many areas as possible. The comparative excerpt relative to the recovery of gravid females both in Deolali and the Barsi Light Railway sector is as under—unfortunately Mr. Lindberg does not show the actual figures for the egg-bound females and makes no mention whatever of males. The numbers met with in Deolali have been shown with a plus sign and the numerical indicator alongside. Those of the other area by a plus sign alone.

Species	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Nerodia piscator... ...	+2	...	...	...	...	...	...	...	...	...	...	...
Macropisthodon plumbicolor.	+1	...	+	+	+	...	...	...	...	...	...	+1
Ptyas mucosus	...	...	...	...	+	+1	...	...	...	...	...	...
Zamenis fasciolatus ...	+1	...	...	...	...	...	...	..	...	...	...	...
Dipsadomorphus trigonatus.		...	...	...	+	+	+ +1	...	...	...	...	...
Coluber helena	...	...	...	...	...	+1	+	...	...	...	...	...

To sum up the position we find:—

(1) Sex disparity—1 male roughly to every 8 females;

(2) Pairing infrequent—one pair in a total of 151 snakes;

(3) Solitary males and gravid females of the same species found at identical times and in almost equal numbers in the same area;

(4) Finding of young 3 to 6 in. long, two to five months subsequent to the appearance of gravid females of the same species—furnishing evidence as to the probable interval required for the fertilisation and incubation of the eggs.

PERIODIC NUMERICAL FLUCTUATIONS AS A RESULT OF SEASONAL CHANGES IN DIFFERENT GEOGRAPHICAL AREAS.

Precise information as to the periodic appearance or absence of snakes in the various geographical areas is lamentably scanty, despite the fact that thousands of these creatures are being killed annually. Mr. Lindberg (February 1932)[1] in his contribution has made a good beginning and the figures he furnishes for the Barsi Light Railway area allow of a comparison being made with those recorded for Deolali. This is well outlined in the graph as under, based on observations made from December 1932 to January 1935 at Deolali, and from August 19, 1929, to August 18, 1931, in the Barsi Light Railway tract, on a total of 151 and 434 snakes respectively.

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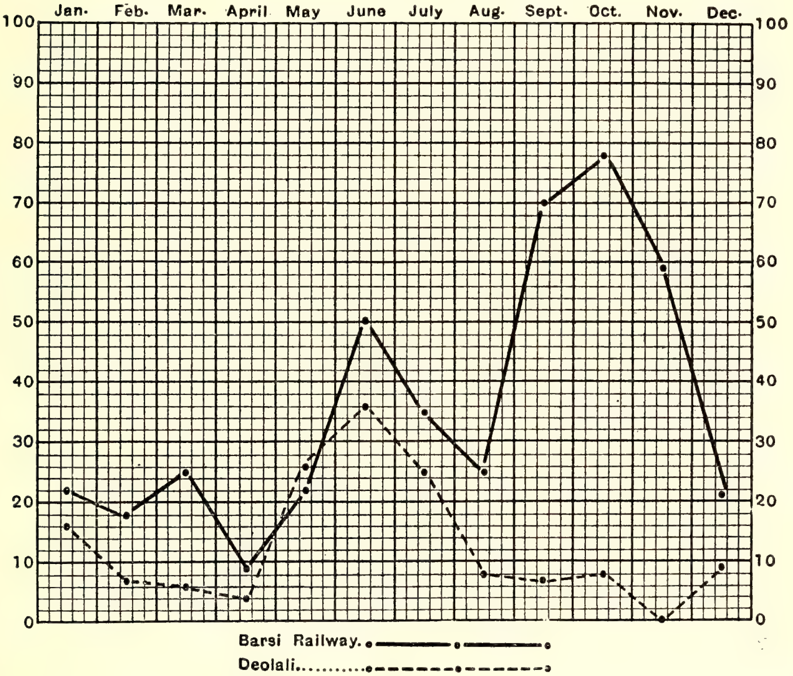
[1] 'Snakes on the Barsi Light Railway (Deccan)', by K. Lindberg, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3, p. 690 (15th February 1932).

Graph showing periodic numerical fluctuations as a result of seasonal changes influencing the appearance and activity of snakes in the different geographical settings of Deolali and the Barsi Light Railway Areas.



The graph shows two peaks—one in June and another, the highest, in October for the snakes on the Barsi Light Railway area. In Deolali there is only one peak during June. There is a notable absence of snakes in Deolali during November. In contrast with this the maximum numerical peak is attained during September, October and November in the Barsi Railway sector. The decline in Deolali on the one hand and the rise in Barsi on the other, during the same period suggests evidence of the effects of environment. The climatic conditions evidently at that time being unfavourable in the one and beneficial in the other locality to practically the same species.

The complete absence of snakes in Deolali during November of the two years' period of observation is significant. About the

2nd November the cold weather is ushered in, and the change in temperature is somewhat acutely and abruptly established. It may be that the sudden drop in the temperature instinctively warns the creature and operates by keeping it temporarily confined, but not necessarily in a state of hibernation. This phase would probably represent the coincidental instinctive urge working in the expectation of a continued and increasingly severe cold setting in, like that experienced by their congeners in the very cold regions of the world, where as a result of prolonged subjection to a reduced and sustained temperature a complete torpidity or 'Winter sleep' is produced. As the minimum temperature at Deolali is at its lowest usually 44°F. and the diurnal range being great, the cold conditions here cannot induce in them, more than if at all a transient sluggishness, which passes quickly causing them to reappear in December. Further, it is noteworthy that the snakes did not disappear during the severe cold spell experienced in January 1935, when the minimum temperature fell to 31°F. and fluctuated at between 34° and 40°F. for about ten days. So rigorous was the cold that the fruit in the Nasik vineyards and orchards were greatly damaged by frost. Under these conditions of an extreme and sudden temperature reduction one would have expected not to find any increase in the numbers of snakes—yet 9 specimens were recovered during that month. Curiously enough their instincts on this occasion acted in an apposite direction and drove them out from their coverts into the warmth of the day. Certain living species which were kept in captivity at the time of the cold wave period did not go into hibernation nor was there the least sign of any torpidity in them. This may have been due to the fact that they were protected in boxes with a minimum of aeration.

POST-MORTEM, DIETARY AND OTHER FINDINGS IN THE ALIMENTARY CANAL.

It is a well-known fact that snakes can go for very long periods of time without a meal. There is the instance quoted by Mr. Prater (1926)[1] of a Python which refused food for ten months; and another in the Paris zoo which is said to have fasted for two and a half years. The writer himself kept and used as controls in some experiments, several living specimens of different species for eight months without food, giving them only water, without the least effect on their vitality. In the free state comparatively few are found with the alimentary canal containing evidence of an ingested meal. Of 112 specimens dissected, only 19 proved positive—approximately 17%. This suggests that the food factor does not loom very largely in their existence. Their specialised capacity for fasting tides over many long intervals of enforced starvation as during hibernation or other anxious occasions in their lifetime.

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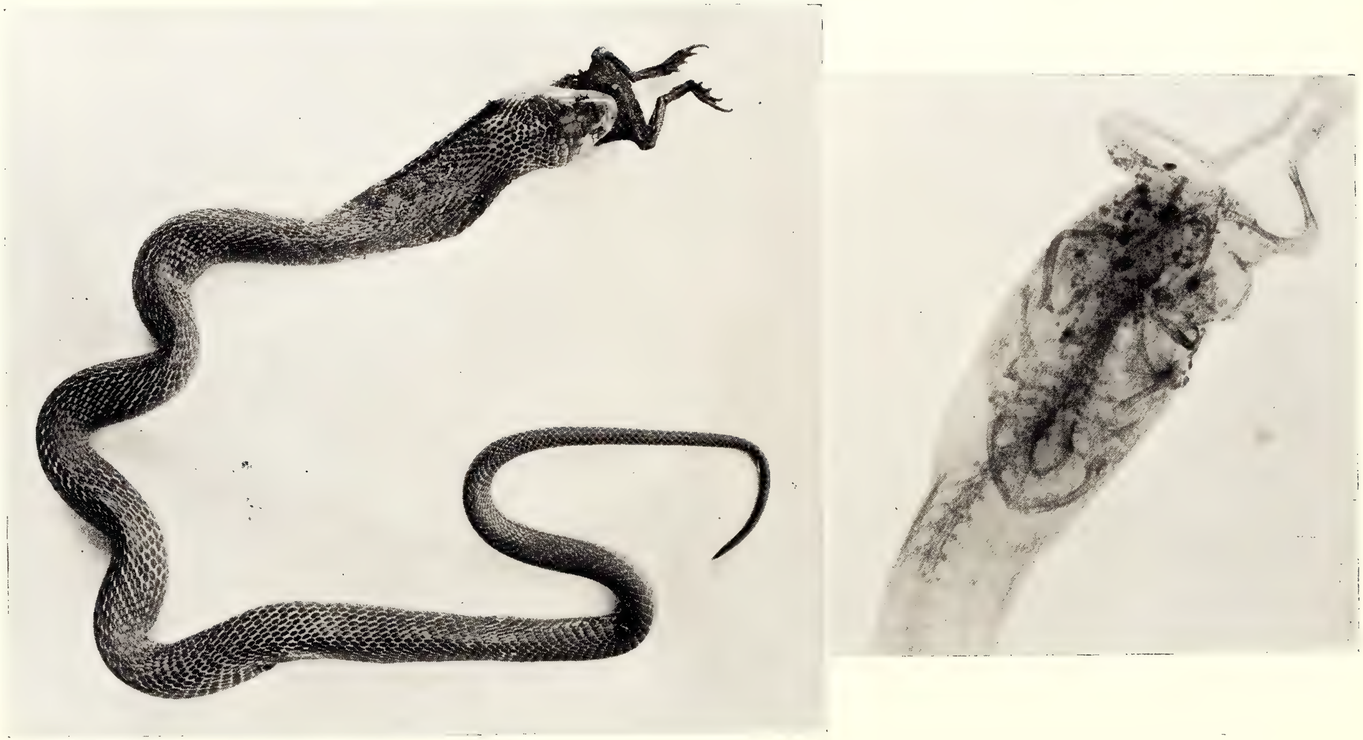
[1] *The Snakes of Bombay Island and Salsette,* by S. H. Prater, C.M.Z.S., p. 3 (1926).

PLATE I.



Cobra *N. naia* swallowing a frog.

Photo by *C. Diaz, Deolali.*

The following is the dietary findings as ascertained by post-mortem investigation:—

Species	Number Positive	Remarks
Nerodia piscator	3	Fish and frogs.
Ptyas mucosus	2	Rats and in one a lizard (species unknown).
Coluber helena	1	Rats.
Naia naia var. *cæca* ...	3	Rats and frogs and in one a Pipistrel bat.
Macropisthodon plumbicolor ...	3	Frogs.
Lycodon aulicus	2	Lizard (*Gecko*) and scorpion (*Buthus sp.*).
Dipsadomorphus trigonatus ...	3	Lizard (*Calotes versicolor*).
Eryx conicus	2	Palm squirrel.
Echis carinata	2	Earthy matter and rootlets.
Bungarus cæruleus ...	1	Earthy matter.
Typhlops braminus ...	1	,, ,,

A specimen of *Nerodia piscator* furnished an example of voracious feeding. The post-mortem revealed nine frogs and seven fish of varying sizes. The largest fish measured 3½ inches. Those which had reached the small intestine were partially digested. From below the throat backwards the alimentary canal was loaded with the fare. Unfortunately the photograph taken of the dissected snake with its victims laid alongside proved to be overexposed.

In one *Ptyas mucosus* a lizard was found—a striped variety, which is frequently here seen in the open country. The zoological classification of this lizard is not known to the author. The specimen has been sent to the Bombay Natural History Society for identification.

A Pipistrel bat was discovered in a cobra. This is a very unusual find and is particularly intriguing in view of the fact that the snake had been killed at 9-30 a.m. on the ground surface in the compound enclosure of a bungalow. One can, of course, only conjecture as to the how, when, and where of the circumstances, which caused the pipistrel to become a victim. It would be a reasonable surmise to say that the snake had secured the bat during daylight in the roof of the house, and cobras have sometimes been found in such situations; but on dissection the pipistrel was found in the alimentary canal in a position corresponding to the region of the hood. This fact would indicate that it had probably been swallowed some two or three hours previously. In the writer's experience, observations maintained in order to ascertain the time required for the complete digestion of frogs and lizards in the green keel-back (*Macropisthodon plumbicolor*) and the common cat-snake (*Dipsadomorphus trigonatus*) showed, that digestion is completed with no trace of even the victim's bones in approximately 72 hours. So that on this basis of calculation the pipistrel must have been seized in the early hours of the morning, either on its return to the roost in the eaves of the building, or at the ground level under conditions of a handicap, which is very obscure and a futile speculation. Whatever the facts may have been it is nonetheless interesting to record this unique diet item in the menu fare of a cobra.

It may interest the reader to know how the time factor of 72 hours, estimated as required for a snake to completely digest a bolus, was arrived at. This was due to the accidental discovery, that red silk cord or thread is not subject to the action of the digestive juices secreted in the alimentary canal of the snake. It passes through quite unaffected. It came about in this way: For want of something better an attendant used a thin red silk cord slip knotted at one end to ensnare a medium-sized lizard (*Calotes versicolor*). Having secured it, he placed the lizard in a box containing a live *Dipsadomorphus trigonatus.* In doing this he cut the thread a short length from the slip knotted end which encircled the neck and dropped the lizard into the box. Some days later after the snake had feasted and digested the meal, the red silk cord was noticed lying in the box. The snake had obviously ejected it *via* the vent. The fortuitous omission to remove the red cord from the lizard in the first instance, led to many experiments being carried out in which the cord was used—not necessarily red, but the colour was convenient—tied to the legs of frogs and lizards and time records maintained from the moment they were swallowed until the cord had passed through the cloaca. This period in all cases worked out at 72 hours for the cord, but digestion must have been effected in a little under this timing.

Macropisthodon plumbicolor was found to feed solely on frogs, which appear in great numbers during the monsoon months. One of these snakes displayed in the matter of food a selective sense which is of interest. A male toad (*Bufo melanostictus*) was placed along with an adult specimen of this species. The toad appeared to realise the presence of the snake; as it showed during the first day very definite signs of fear. When at sundown the snake began to actively move about in the box, the toad exhibited great agitation and persisted in jumping at the intervening glass panel between it and freedom. If the snake approached too near, it quickly hopped away to a safe distance. On the second day the toad showed some composure, but behaved as on the first day if the snake at any time came near. On the third day surprisingly enough it evinced no dread whatever and was seen during the day calmly perched upon the coiled snake. On the night of that day the snake's activities did not in the least disturb its equanimity and it even allowed the snake to approach and pass it without leaping away. On the fourth day the toad showed signs of desiccation and did not appear too well and as the snake had shown no desire to swallow it, the toad was removed and placed in water. On the night of the fourth day a frog was secured and put in the box and significantly enough the snake at once seized it at the side of the neck and raising it clear off the floor held the frog firmly, while it squawked in terror—not all frogs make this sound, the majority are silent and stupidly inert when being swallowed. The snake maintained its hold for 12 minutes until the frog ceased to struggle and while it was still alive and without having recourse to using the floor of the box, the snake veered the frog around by a gulping action until the head entered its mouth, when it began to swallow by alternating movements of the jaws. It then rubbed its neck by vigorous pushing movements along the floor of the box until the bolus had passed the cervical region. Plate I shows a cobra (*N. naia*) in the act of swallowing a frog.

A common Wolf Snake (*Lycodon aulicus*) was killed in the act of swallowing a scorpion. As the back of the snake had been broken it had ejected the scorpion when in its death throes. This information was given when the snake and the scorpion were separately brought. On examining the scorpion it was noticed that the maxillary palps, the chelicerae and the telson were missing. Dissection of the snake proved the alimentary canal to be empty. Further inquiry elicited no clue as to the missing parts of the scorpion, and an assurance was given that it had been brought as found. The snake when first observed was on the verandah of an Indian dwelling. How the parts of the scorpion came to be missing must remain a mystery.

In the writer's garden one night at 11 p.m. an interesting incident was brought into view by the flash of an electric torch which revealed but did not disturb either the snake—an adult *Dipsadomorphus trigonatus*, or the lizard—a small-sized *Calotes versicolor.* The lizard could not have been aware of the snake's approach. At the moment the light was flashed in their direction, the lizard was seen perched at the foot of a shrub and the snake was actually in the act of seizing its victim by a darting movement. It did so at the side of the lizard's neck and thereupon a desperate struggle ensued. Both snake and lizard rolled over on the ground; the lizard making frantic endeavours at escape and even dragging the snake along for a short distance. The snake then coiled itself around the lizard's body and prevented it from further progression and struggling. Presently a lull in the proceedings occurred, as the lizard now showed signs of exhaustion. It was breathing very heavily, but nevertheless still made futile and weakened efforts to free itself. After 16 minutes had elapsed the lizard commenced to sag and showed the onset of a moribund phase, depicted by a drooping of the head and closure of the eyelids. A further three minutes ushered in convulsions. The snake at this juncture released for the first time both its mouth and body hold and moved to the lizard's front. It then once more seized the head and while the lizard was still alive and breathing it commenced to swallow. This it did with a series of gulping movements, often seen in the farmyard when a chicken attempts to swallow too big a bolus of food—the forward and upward throwing of the head and short jerk back motion with distended jaws, tossing the lizard in the air to assist the effort. The jaws of the snake then moved alternately and independently to enable the teeth exerting a traction force backwards on the head and body with each fresh alignment taken. It occasionally rubbed the lower parts of the jaw and neck along the ground by way of aiding deglutition. When it had half swallowed the lizard the snake was lifted up without signs of resentment and put into a box. The species of lizard mentioned above has been a constant find in the gut of this snake. Other observers have found chickens and eggs in this species.

In *Eryx conicus* the grey-striped squirrel (tree rat) was found. Mr. Lindberg (1932)[1] also mentions an instance of one of these snakes observed in the act of capturing a squirrel.

A point of interest noted in all the snakes, whether alive or dissected, was the outstanding fact that they swallow mammal, lizard, frog or fish, head first. This is an instinctive habit which mechanically facilitates the downward passage of the dead body which is ingested with the legs posteriorly deflected and folded in underneath. Muscular contractions of the ribs further aid lateral compression and propulsion backwards of the bolus. Were this not the case the dead lizard's spined dorsum and the clawed feet of frogs and mammals would be caught up and become impacted causing an obstruction in the alimentary canal.

In two specimens of *Echis carinata* the large intestines were astonishingly enough loaded with caked earthy matter in a half dry state and admixed with filamentous lengths of rootlets. Plate II depicts one of these snakes with its loaded bowel contents throwing the dark shadows of this substance. It is regretted that a sample was not retained for chemical analysis. X-Ray pictures of *Bungarus caeruleus* (Krait) and *Typhlops braminus* also show to a lesser extent earthy matter in the alimentary canal, both of which were confirmed by dissection. All of these snakes were free from any helminth infestation. This point is mentioned because in another snake, *Nerodia piscator*, the gut was crammed with a green and rather stiff water weed, which had become entangled with a mass of worms (nematodes), a few of which were alive and clinging to the stomach wall. Here the suggestion is strong that the weed had been swallowed on purpose as a curative measure in order to both dislodge the worms and kill them. The vermifugal and vermicidal action was certainly evident, because the majority of the worms were dead, judged by the discolouration of their bodies in contrast with the few living worms which were pinkish white and exhibiting movement. It was owing to these few still living forms being imbedded and attached to the stomach wall that the mass was held up in its backward motion in and through the alimentary canal.

The question of interest arising in the finding of earthy matter in the bowel of the snake is, whether earth-swallowing is also a habit with the snakes akin to that generally observed amongst other animals (salt licks)? The writer is unaware of a similar instance having been previously reported by other workers. Since the percentage works out at roughly 2 per 100 of the killed numbers in this survey, there is reason to believe that it is at times necessary for them to swallow earth in order to fulfil a physiological purpose.

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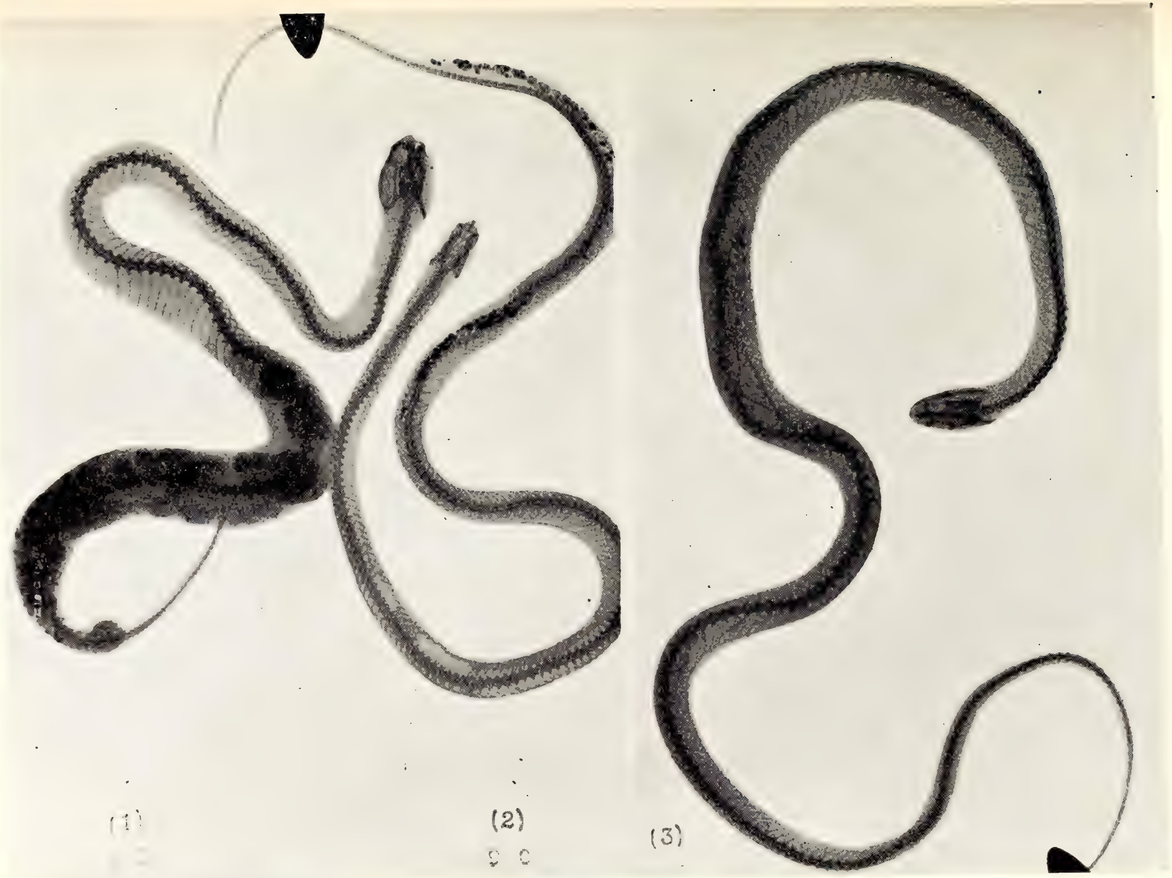
[1] 'Snakes on the Barsi Light Railway (Deccan)', by K. Lindberg, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3, p. 690.



(1) *Echis carinata* (Schn.), The Saw Scaled Viper. Showing the lower bowels loaded with earthy matter.

(2) *Bungarus caeruleus* (Schn.), The Common Krait. Showing earthy matter in the lower bowels.

(3) *Rhabdophis stolatus* (Linn.), The Buff-striped Keelback. Showing the remains of an ingested meal—the bony outline of a lizard (?).

Radiograph by *C. P. Coshan, I.M.D.*

Cannibalism amongst snakes is a feature, which has been occasionally recorded. There were no examples of it noted at Deolali. The habit is evidently atavistic and confined to only a few.

About 12 per cent of the snakes dissected were infected with nematodes. It appears to be a disability in a general way common to most of the species. It must act as a considerable handicap, serving as a check to increase in their population. Those suffering from worms reject food. Several died early in one to two months of captivity. Post-mortem investigation revealed heavy infestations with worms in bunched masses occupying the stomach section of the alimentary canal.

Exfoliation.

The snake as is well known periodically throws off the epidermic investment. In order to ascertain the extent to which this is done and the manner in which it is brought about, a certain number of snakes were kept under observation for eight months. These were made into two series. One set from which the food was withheld, acted as controls for the other fed with such frogs, tadpoles and lizards as were procurable. All were watched and inspected as time and opportunity offered throughout the period. Receptacles containing water were kept replenished in their boxes, but were put in only from 18th April onwards. The number of times each snake in the respective series desquamated is shown as under:—

Species	Series No. 1 (fed).									Series No. 2 (Fasting control).								
	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Moults	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Moults.
Macropisthodon plumbicolor ...	.	...	...	1	1	2	1	...	5	1	...	...	...	...	1	...	...	2
Macropisthodon (young) ...	...	1	...	2	1	2	2	1	9	...	...	1	...	...	...	...	...	1
Nerodia piscator (young) ...	1	...	1	1	2	1	2	2	10	No control available.								
Lycodon aulicus.	...	...	1	...	1	...	...	...	2	...	1	...	...	...	...	...	...	1
Dipsadomorphus trigonatus ...	1	...	...	1	...	1	...	1	4	...	...	...	1	...	...	...	...	1
Oligodon tænio-latus ...	..	...	1	...	...	..	...	...	1	...	...	...	...	..	1	...	...	1

Desquamation occurred most often at night and was as a rule a complete cast. There are preliminary phases. For a day or two a change to a darker colour shade is noticeable. The outer layer of the epiderm is then seen to be slightly raised and wrinkled between each scale division. This roughening presents the appearance of a powdered surface owing to the whitening of the older exoskeleton.

The latter then loosens and lifts throughout the body length and as the caudal section is freed, the snake by opening its mouth widely several times releases the investments on the dorsal and ventral aspects of the head and by free movements over the ground surface crawls out of the detached cast. In some cases the epiderm becomes adherent in parts especially on the head. In such examples there is a general splitting of the covering, which then peels off in the course of a few days. During this time the snake is temporarily blinded unless the old antocular membrane becomes detached and is shed. Some snakes when afflicted in this way immerse themselves in water and get rid of the old skin.

The greater number of desquamations occurred amongst the fed series; apparently this must be a measure of the growth occurring as a result of the feeding. The control series probably reflect more truly the actuals taking place in the free state.

The following impressions were gained. The young specimens exhibited much greediness and fed voraciously, not as a regular daily feature, but at irregular intervals. The young water snake showed a perference for tadpoles and when these were available eschewed the frogs. It remained immersed in the water for most of the time. The adult specimens also fed irregularly and displayed the greatest activity at night; and when not feeding moved restlessly about looking for a means of egress. *Lycodon aulicus* fed sparingly, and it is doubtful whether *Oligodon taeniolatus* fed at all.

THE SNAKE'S BASKING HABIT CONSIDERED IN RELATION WITH SUN TRAUMATISM PRODUCED IN THEM AS A RESULT OF DIRECT EXPOSURE TO THE SUN'S RAYS.

The snake's basking habit has been frequently observed and recorded, more often as a marked feature peculiar to the vipers, and fresh water species. Whether it is general and indulged in by all snakes is not clear. The writer while on fishing excursions during the cold months of the year has often seen *Nerodia piscator* lying upon the river's bank exposed to the direct rays of an afternoon sun. As these snakes invariably returned to the water on one's approach it was found impracticable to time the period they remained so exposed. Snakes being poikilothermic or cold-blooded any prolonged exposure to the sun's rays must act adversely by disturbances set up in the metabolic balance and heat regulating centre, producing a sun traumatism resulting in death. As a matter of ecological interest, therefore, experiments were carried out by placing these creatures in the sunlight and estimating the time required for bringing about hyperpyrexia and death. For this purpose a bare patch of ground was selected free from any holes, away from trees and thus devoid of any shade. The snakes were allowed one at a time to roam freely over this area, but prevented from leaving it. It is greatly regretted that no solar radiation thermometer was available for those experiments; though the ordinary shade temperature readings have been recorded. The results of these experiments are set out in the table as under.

Species	Date of Experiment	Temperature		Time of Day	Sun trauma produced in minutes	Death in minutes	Remarks
		Maximum in the shade	Minimum in the shade				
Dipsadomorphus trigonatus ...	14- 5-1934	92	76	10 a.m.	25	28	clear sky.
Do. ...	14- 5-1934	103	76	2 p.m.	4	6	,,
Do. ...	20- 9-1934	86	68	11 a.m.	50	57	,, and some clouds.
Do. ...	18- 1-1935	76	36	10 ,,	83	85	cold and frosty.
Lycodon aulicus.	14- 5-1934	92	76	10-35 ,,	4	5½	clear sky.
Do. ...	20- 9-1934	86	68	12 noon	10	12	cloud and sun.
Do. ...	3-12-1934	82	45	3 p.m.	12	14	clear sky.
Cobra ...	14- 5-1934	103	76	2-30 ,,	6	8	,,
Do. ...	20- 9-1934	86	68	2 ,,	58	62	cloud and sun.
Do. ...	12-12-1934	82	48	3 ,,	66	68	clear sky.
Do. ...	16- 1-1935	80	33	2 ,,	70	74	,,
Eryx conicus ...	14- 5-1934	93	76	11 a.m.	4	5	,,
Macropisthodon plumbicolor ...	14- 5-1934	96	76	11-30 ,,	15	18	,,
Do. ...	14- 5-1934	103	76	3 p.m.	2	3	,,
Do. ...	29- 6-1934	79	70	10 a.m.	32	35	cloud and sun.
Do. ...	3-12-1934	82	45	2 p.m.	25	27	clear sky.

The foregoing experiments show that certain species manifest a greater tolerance, as evidenced by the Cobra, over others, like *Lycodon aulicus*, are more susceptible and quickly overcome by the heating of the body. No vipers were forthcoming for comparison in these experiments. All the snakes used behaved exactly alike and showed a similar train of symptoms. They manifested an active restlessness, working the tongue ceaselessly the whole time. Every effort was made to regain the cool shade of the trees and, remarkably enough, in doing this they evinced a sense of direction, by moving toward an avenue of trees which flanked the bare patch within which they were compelled to remain. Even when their heads were directed in the opposite direction—away from the avenue—they turned about and unfailingly moved towards it. Some of them willingly and eagerly followed one in order to reach the shadow cast by one's body. This state of activity continued until the heat engendered within the body, as a result of the muscular output combined with the heat rays from the sun and presumably also excess formation of lactic acid in the tissues, caused hyperpyrexia. This was evidenced by inertia (slowing of the movements), loss of incoordination (swaying of the head and rolling over of the body on to the back in the efforts at progression). Coma was then ushered in by complete cessation of locomotion—widely distended jaws and laboured breathing—which finally ended in death. In the male the generative organs prolapsed.

The Cobras, in the early stages, remained stationary and alert with erected heads and expanded hoods in a state of defensive aggression, until the heat from the sun's rays compelled them to a realisation of the discomforts in the situation and soon reduced them from the sublimity of a venomous intimidation to one of ridiculous and abject submission.

It is clear that the habit of basking must necessarily be restricted to the time period required for regulating the body temperature to the optimum conducive to comfort and well being, as after emergence from hibernation, or as in the case of the aquatic types after prolonged immersion in water during the cold weather. Col. Fayrer (1872)[1] referring to the vipers, remarks that the temperature of the gravid female increases during gestation and that a higher body temperature than that which is natural to the viper in its ordinary condition is necessary to effect the incubation of the eggs. The gravid female is said to then expose herself to the heat by basking in the sun's rays. Most of the past recorded evidence involves mostly the vipers. Such information as there is sadly lacks in the essential details as to the time and day of the year, the sex and other relevant particulars.

During the cold wave period of January 1935, the Military Dairy Farm Manager, Deolali, shot with a single round (No. 4 buck shot) two gravid *Nerodia piscator*, which were basking together at the same spot on the river bank at 9-30 a.m. on 9th January 1935. The author's experience is limited to a single Russell's Viper, which was secured during March 1927, at about 10 a.m. when sun bathing in the precincts of the Pasteur Institute, Kasauli (Simla Hills). Mr. Strover[2] reports the finding of an *Echis carinata* at 3 p.m. on 8th January 1933 in the environs of Peshawar. Mr. Prater (1926)[3] also found the same species on two different occasions at Santa Cruz and Andheri. He remarks that the corrugated zinc forming the roof of a hen coop upon which the viper basked was hot to the touch and at a time during the afternoon.

LOCOMOTION.

This reaches its highest attainment—so far as the Deolali snakes are concerned—in *Ptyas mucosus* and appears to be a specialisation confined to that species showing a well developed musculature, nearly uniform body thickness proportionate with great length. As regards *Ptyas mucosus*, personal observations go to show that the speed is equal to that of the average running pace of a man. This rate, apparently, cannot be maintained for any great distance, particularly by the full grown older specimens over 8 ft. in length. In this snake locomotion takes the form of an almost straight course in the direct axis of the body with a slight wavy side to side swing. In *Python molurus* the movement is practically straight and slow, because of the excessive thickness and weight. There are gradations from this standard in which the zigzag motion is but slightly more exaggerated, or greatly emphasised. The following line drawings depict the various forms of locomotion observed.

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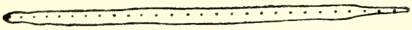
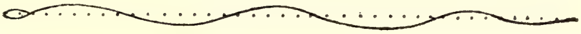
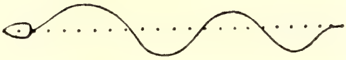
[1] *The Thanatophidia of India*, by Col. F. Fayrer (1872).

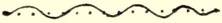
[2] The Saw-Scaled Viper (*Echis carinata*) about in Winter, by C. H. Strover, B.A., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 3 (15th August, 1933).

[3] *Snakes of Bombay Island and Salsette*, by S. H. Prater, C.M.Z.S. (1926).


Python molurus


Ptyas mucosus


Vipera russelli


Lycodon aulicus

On an average, locomotion is poorly developed, unwieldy, and the rate of progression slow. If excited, the smaller snakes work their bodies so vigorously, that the spiral curves in the side to side motion become greatly increased and progression is retarded. If not directly operating as a handicap in the quest for food, it is clear that even the maximum speed often fails in helping snakes during daylight to escape from their greatest enemy—man—and unless there are holes in the ground, or thickly grown vegetation near to them, their chances for getting away are reduced to a minimum. The inherent fear of snakes entertained by mankind in general is a much more valuable factor in making escape possible for them. Hence it is that only the larger species have developed speed as a speciality, possibly because their habits are partly diurnal. As regards the search for food, speed is not an essential requirement. It is chiefly during the nocturnal perambulations, that they meet with a great measure of success, the victims being either somnolent or else suddenly taken unawares.

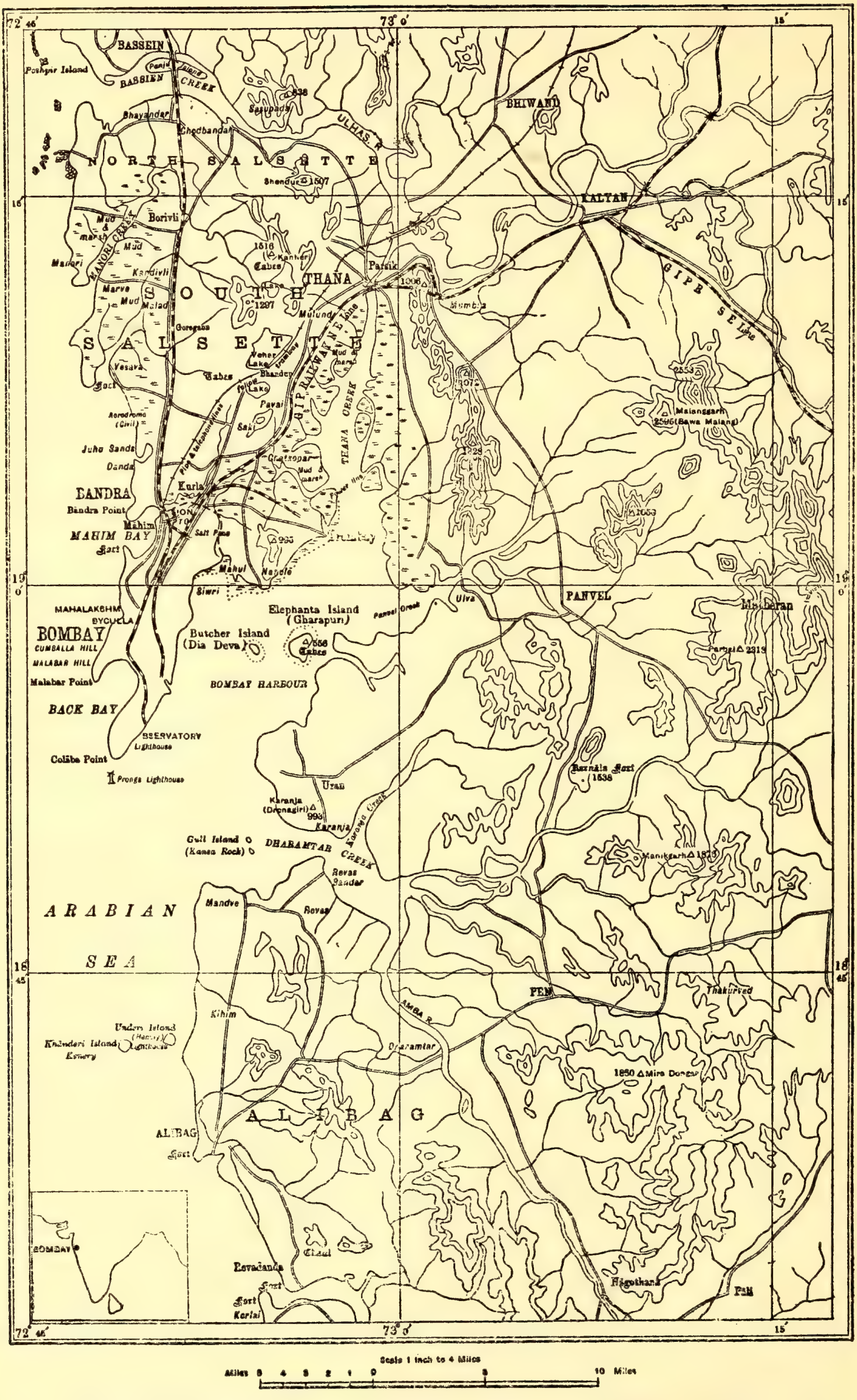
The *modus operandi* in locomotion is brought about by the combination of muscular action on the ribs causing them to execute a sweeping laterally depressed motion by which the abdominal scutae obtain a purchase on the ground surface and propel the body forward in movement. The intercostal muscles are contracted by sectional waves passing from the neck backwards—this is well seen in *Python molurus*, in which each contraction wave involves approximately eight pairs of ribs. Each section is independent in action, the ribs in it working together. The waves of contractions following rapidly in succession present a rhythmic uniformity in the movement of the ribs, which can be distinctly seen in sectional motion under the epidermis. The longissimus dorsi and semi-spinalis dorsi muscles direct torsion and lateral flexions of the body (vertebral column), which are controlled by the articulations of the vertebrae to be described later.

NOTE ON THE PECULIAR USE MADE OF THE TONGUE BY SNAKES AND SOME LIZARDS.

A striking feature in the behaviour of a snake is the peculiar use it makes of its tongue. The cause of this seemingly purposive act is not generally understood. A like action of the tongue is observed in some species of lizards (the monitors), whose tongues are similarly bifid and protractile. The habit as noticed amongst the *Ophidia* synchronises with the exercise of muscular activity, such as locomotion, or in the case of the Cobra, when the hood is expanded and the anterior third of the body is erected. It is only in these active states that these creatures shoot out the forked tongue in quick succession. The act appears to be in the nature of a physiological expression of some function serving to their benefit. The author is unaware of any scientific explanation for this characteristic behaviour. Any theoretical considerations offered in elucidation of the act must necessarily be advanced on some physiological ground. In the experiments outlined in this paper relative to the effects of exposure to the direct sun's rays, the observation with regard to the constant use of the tongue made by the snake led to the consideration that this organ in view of its bifid construction may not altogether be a sensory one. The suggestion is strong that it may also serve a second important function by helping considerably in the maintenance of the thermal balance, in preserving it at the level necessary for the well-being of the organism. Snakes being cold-blooded, their temperature varies with the surrounding medium and is normally a degree or two above it. Any muscular output is always attended by heat production in the tissues and there must be some means for eliminating the heat engendered, especially in an animal which is totally unprovided with sweat glands. In view, therefore, of the fact that the act is a spontaneous one and associated with muscular activity alone, there are tenable reasons for believing that the heat formed in the tissues is got rid off by evaporation of the moisture from the extruded surface of the tongue. Analogous examples of the kind are seen in homoiothermal animals (warm-blooded) whose skins are in part devoid of sweat glands, as in the familiar instance of the overheated and panting dog. Again on very hot days, birds open their beaks and extrude the tongue for a similar purpose.

Conversely, in very cold weather the temperature of the snake is considerably lowered and body metabolism reduced, as a result there is less heat formation. A prolonged reduction in the temperature of the external air causes the snake to go into hibernation.

(*To be continued*).


72° 46'
73° 0'
15'
19° 15'
19° 0'
18° 45'
BASSEIN
Panju Island
Poshpur Island
BASSIEN CREEK
Sasupada
ULHAS R.
BHIWANDI
Bhayandar
Ghodbandar
NORTH SALSETTE
Shendur 1507
KALYAN
Borivli
Mud & marsh
MANORI CREEK
Manori
Kandivli
Marve
Malad
1516
Kanheri
Caves
THANA
Parsik
1006
Mumbra
1297
Mulund
Goregaon
SOUTH SALSETTE
G.I.P. RAILWAY N.E. line
G.I.P. S.E. line
Vesava
Fort
Vehar Lake
Bhandup
Tulsi Lake
Powai
Saki
TRANA CREEK
Aerodrome (Civil)
Juhu Sands
Danda
Ghatkopar
Kurla
BANDRA
Bandra Point
Mahim
MAHIM BAY
Fort
SION
Salt Pans
Mahul
Siwri
Trombay
965
2553
Malanggarh
2596 (Bawa Malang)
1653
1229
1076
PANVEL
Ulva
Panvel Creek
Matheran
Parbal 2313
MAHALAKSHMI
BYCULLA
BOMBAY
CUMBALLA HILL
MALABAR HILL
Malabar Point
BACK BAY
OBSERVATORY
Lighthouse
Colaba Point
Prongs Lighthouse
Elephanta Island (Gharapuri)
556
Caves
Butcher Island (Dia Deva)
BOMBAY HARBOUR
Uran
Karanja (Dronagiri) 993
Karanja
Karanja Creek
Karnala Fort 1538
Gull Island
(Kansa Rock)
DHARAMTAR CREEK
Revas Bandar
Revas
Mandve
Manikgarh 1873
ARABIAN SEA
PEN
Thakurwad
AMBA R.
Kihim
Undari Island (Henery) Lighthouse
Khanderi Island (Kenery)
Dharamtar
1850 Mira Dongar
ALIBAG
ALIBAG
Fort
BOMBAY
Chaul
Revadanda
Fort
Fort
Korlai
Nagothana
Pali
Scale 1 inch to 4 Miles
Miles 5 4 3 2 1 0 5 10 Miles

The Islands of Bombay and Salsette with the adjoining mainland.

THE BIRDS OF BOMBAY AND SALSETTE.

BY

SÁLIM ALI and HUMAYUN ABDULALI.

PART I.

(*With a map and four plates*).

INTRODUCTION.

(*a*) *General.*

This paper is the second of the series on the fauna of Bombay and Salsette.[1] It is the result of many years of casual observation supplemented by more systematically kept notes and records by one of us (S. A.) between 1924 and 1929, and by the other (H. A.) mostly from 1931 onwards. The few specimens that were collected by Sálim Ali were mainly for the confirmation of subspecific attributions. A fuller and more representative collection has since been made by Humayun Abdulali for his college museum (St. Xavier's). He was particularly successful in his nesting activities, a fact which has made possible somewhat greater completeness in our accounts. We have also taken advantage of the notes made by Mr. Prater during his residence in the suburbs at Andheri between 1923 and 1924. All previously published records relating to our area and its vicinity have been collated as far as possible. Where a likely species has not actually been known to occur or breed within our limits, the nearest record we can trace on the adjoining mainland has been cited, as there seems to us no sufficient biological reason why most of such species should not at some time or other also be found on the islands.

Nothing like exhaustiveness is claimed for the paper. It is merely offered in the nature of a working list and as a framework on which other observers can build. Later on it is intended to be issued as a Prince of Wales' Museum publication in booklet form and as a companion to *The Snakes of Bombay Island and Salsette*. In order, therefore, to make it a more useful guide to the public we have, at the suggestion of the editors, given at the head of each species a rough general description as an aid to field identification. Where the scientific names differ considerably, those by which species are referred to in EHA's *Common Birds of Bombay* are also given for the reader's convenience.

All the skins, including some old ones from the collection of the Bombay Natural History Society, have been examined, and racially determined for us by Mr. Hugh Whistler to whom we wish to express our thanks.

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[1] The first, on the Snakes of Bombay and Salsette by S. H. Prater, appeared in vol. xxx, pp. 151-76.

(*b*) *Historical.*

The town and island of Bombay have undergone stupendous transformation since the days when E. H. Aitken (EHA) wrote in the *Times of India* the inimitable chapters that now comprise his almost classic *Common Birds of Bombay*, and since E. C. Comber compiled his bird list for the Bombay Government Gazetteer. The evolution has been particularly aggressive since the beginning of the present century. Salt marshes and mud flats where in the eighties and nineties the old redoubtables like Aitken and Inverarity hunted curlew, snipe and golden plover, have since been filled and reclaimed and either intensively built upon as at Tārdeo, or altered out of all recognition into delightfully green and well kept playing fields as of the Willingdon Sports Club or the Race Course at Mahāluxmi, justly acclaimed as one of the finest in the East. Worli and Māhim which until quite recently were one vast stretch of dense, gloomy cocoanut groves have now been cleared and built upon or opened up into spacious promenades, playgrounds or wide arterial thoroughfares. The low line of hills flanking the sea at Worli has been levelled for the most part, and extensive development and colonising activity has also taken place at Sewri and in the outlying areas around it. Tanks such as the Gowālia, Bābūlla and Dhobi Talāo have been filled as part of the widespread anti-malarial campaign, thereby driving out the few remaining dabchicks from their last defences.

Where but a few years since the call of curlews, oyster-catchers and sandpipers resounded at low tide through the stillness of night, the hooting of motor horns and the incessant din of scurrying traffic now proclaim Ballard Estate as one of the city's liveliest business centres.

The years immediately following the cessation of the Great War witnessed a particularly feverish spurt of urbanising activity. The short lived boom in trade and industry and the unprecedented influx of population into the city from the outlying districts brought about housing congestion and a soaring of land prices that necessitated expansion into the adjoining island of Salsette. Schemes, both public and private, for the development of areas that had hitherto lain marsh or jungle were ardently undertaken, and even the sea was not immune. An extensive area of Back Bay reaching from Colaba to Chowpatty has been reclaimed. Dānda, Khār, Pāli Hill, Borivli, Chembūr and many other areas hitherto unhealthy low-lying tracts or scrub jungle were reclaimed and developed, and with the simultaneous opening up of good motor roads and fast electric local train services, they sprang up with amazing rapidity into popular and populous residential suburbs.

(*c*) *Topographical.*

The composite island of Bombay on which the city is situated (originally consisting of seven small islets) is one of a group lying off the Konkan Coast 18° 55′N × 72° 54′E. By the construction of causeways and breakwaters in comparatively recent years it is now permanently united on the north end with the larger island of Salsette and so continuously with the mainland. The remainder of the group of islands—Elephanta or Ghārāpūri, Butcher or Dia Deva, Gull Island, Kānsa Rock and others, together with the two further south viz. Underi and Khanderi—constitute a part of the administrative district of Kolaba, but are near enough Bombay to be included in this paper, as is also the case with the mainland immediately opposite them.

The island of Bombay is trapezoid in shape and consists of a low-lying plain about 11½ miles long by 3 to 4 miles broad, flanked by two parallel ridges of low hills. Colaba Point, the headland formed by the longer of these ridges, protects the harbour lying to its eastern side from the force of the open sea; the other ridge terminates in Malabar Hill and between the two lies the shallow expanse of Back Bay. Before the construction of the embankment known as Hornby Vellard the central plain was liable to be submerged at high tide. To the north and east recent schemes of reclamation have similarly shut out the sea and partly redeemed the foreshore for the use of commerce. The coast is low, the highest point—Malabar Hill—being about 180 ft. above the sea. In the extreme north of the island (near Sion and Kolvāda) a large tract of salt-marsh still remains partly unreclaimed. At the southernmost point a dangerous reef—the Prongs—juts out from Colaba Point and on it stands the lighthouse known by that name.

Salsette, with which the northern end of Bombay is connected by means of the Sion and Māhim causeways, is a larger island extending northwards from Bandra for about 16 miles, right up to the Bassein Creek. It is rich in rice-fields diversified by jungle and studded with hills, and has an area of 246 sq. miles. Along its centre, from north to south, runs a broad range of hills which after subsiding into the plain near Kūrla crops up again in the southernmost part of the island of Trombay. The central and highest point—Thāna or Kanhēri Peak (1,516 ft.)—stands a little to the north of Tūlsi Lake, and there is another detached sharp peak—Shendūr (1,507 ft.)—still farther north. Spurs from the main range run west towards the sea, while the low lands are much intersected by tidal creeks which, especially in the north-west (Bhāyandar, Manōri, Malād etc.), split the sea face of the taluka into small islands. The staple crop is rice and most of the uplands are reserved for grass for the Bombay market. The coast abounds in cocoanut groves while the palmyra palm grows plentifully in most parts of the island.

(*d*) *Meteorological.*

The rainfall in Bombay, restricted to the South-West Monsoon (June to September), averages about 75 in. annually. In the better wooded parts of Salsette it is slightly higher. The mean average temperature is 79°F. The climate is equable but humid, The hottest months of the year are May and October, i.e. those which immediately precede and follow the rainy season.

(e) *Vegetational.*

The vegetation does not differ from that of the parallel terrain on the adjacent mainland. Along the coast, flanking the numerous tidal creeks, salt marshes abound with mangrove belts of varying extent, principally *Avicennia* and *Bruguiera*. On the land just above this zone, not under daily tidal influence but inundated at spring tides, the Sea Holly (*Acanthus ilicifolius*) usually thrives. The extensive mud flats on the west of Salsette are studded with small 'islands' that support a sparse growth of grass, Babul, *Salvadora persica*, *Clerodendron inerme* and other xerophytes. They often harbour a small avifauna of their own. If carefully controlled, they provide excellent opportunities for the study of migration as their smallness enables arrivals and departures to be noted with a degree of precision. Beyond this, are found the usual West Coast plants, among them *Thespesia populnea*, *Cocos nucifera* with *Casuarina equisetifolia* and *Calophyllum inophyllum;* while still farther inland the typical vegetation of the Western Ghats and the Deccan Plateau occurs. In the flat country and about paddy cultivation the tree growth consists largely of Karanj (*Pongamia glabra*), Tād or Palmyra palms (*Borassus flabellifer*), Wild Date (*Phoenix sylvestris*), Tamarind (*Tamarindus indica*), Jāmūn (*Eugenia jambolana*), Mango (*Mangifera indica*), Ber (*Zizyphus* spp.), Apta (*Bauhinia racemosa*), Rāyan (*Mimusops hexandra*), *Streblus asper*, Neem (*Melia azadirachta*), and other species. Occasionally Gūlmohōr (*Poinciana regia*), Drumstick (*Moringa oleifera*), Sīmal (*Bombax malabaricum*), Pangra (*Erythrina indica* and *E. stricta*) and Khar Champā (*Plumeria acutifolia*) occur, especially near villages. The scrub and secondary jungle exhibits predominantly bushes and small trees such as *Carissa carandas*, Tōran (*Zizyphus rugosa*)—the latter usually on hillsides—*Ixora coccinea*, *Lantana camara*, *Calotropis gigantea*. The Cobra Cactus (*Opuntia elatior*) is not uncommon in parts, and the roadside hedges and field boundaries are principally the cactus *Euphorbia neriifolia*.

The better wooded parts of Salsette, as for example the country around the three artificial lakes—Tūlsi, Vehār and Pawāi—which provide part of the city's water supply, and the hills in the northern part of the island—contain Teak (*Tectona grandis*), *Grewia* spp., *Albizzia procera*, *Dalbergia* sp., *Garuga pinnata*, *Careya arborea*, *Ficus bengalensis*, *F. glomerata*, *F. religiosa*, *Cassia fistula*, *Feronia limonia*, *Adina cordifolia*, *Gmelina arborea*, *Morinda citrifolia*, *Oroxylum indicum*, *Holarrhena antidysenterica* and other deciduous trees. In addition to many of the bushes common about the open cultivated country, one finds *Helicteres isora*, *Calycopteris floribunda*, *Woodfordia fruticosa* and several species of Karvi (*Strobilanthes*). In the monsoon a host of herbaceous plants spring up, particularly luxuriant in the better wooded northern parts, including various species of *Leea* whose leaves

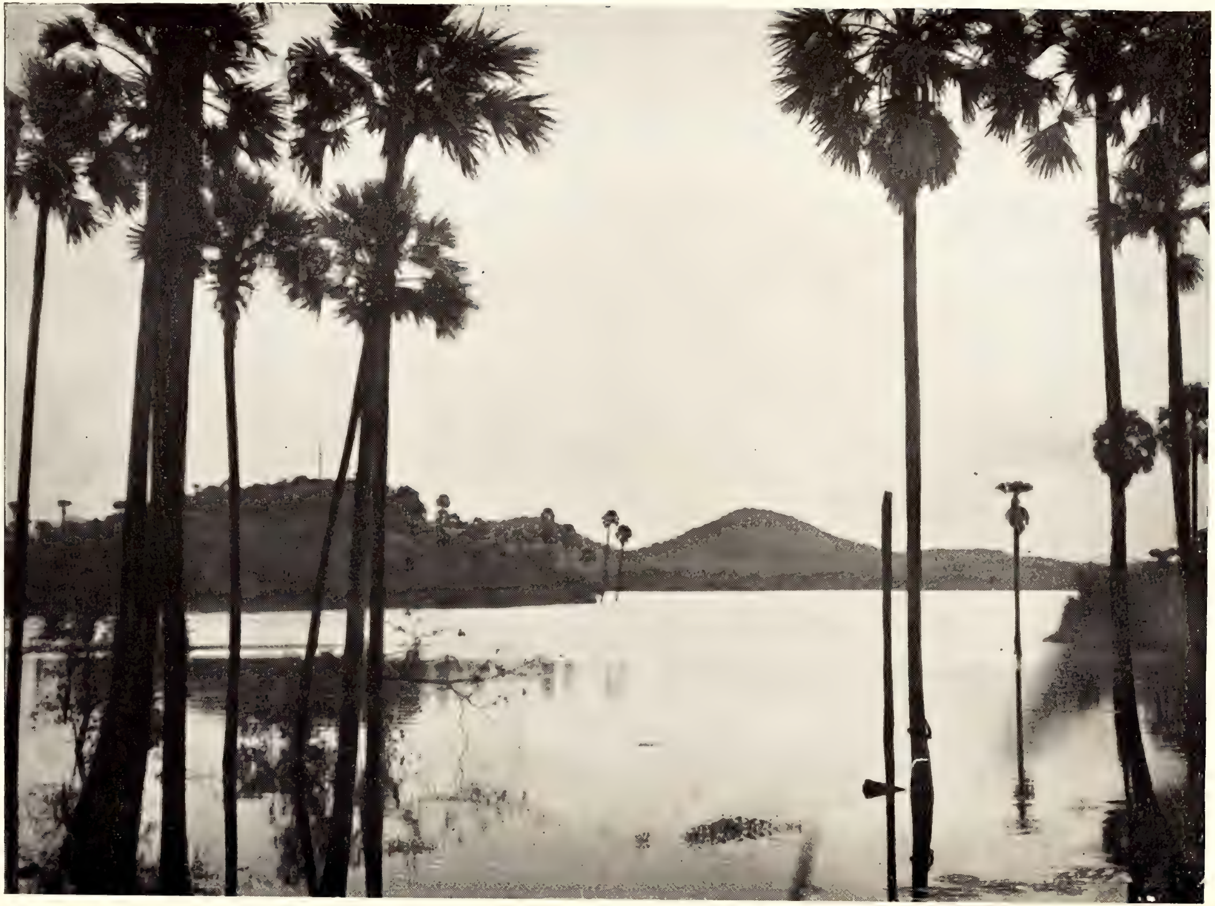


Photo by *Sálim Ali.*

Powāi Lake, Salsette.
'The Naturalist's El Dorado.'

afford favourite nesting sites to tailor birds and other warblers. The excellence of the soil of Salsette for mango and *chikoo* cultivation has long been recognised and there are many large orchards and groves scattered over the flatter portions of the island which provide feeding ground and shelter to numerous species of birds. *Loranthus longiflorus*, *L. loniceroides*, *Viscum articulatum* and other *Loranthaceae* are common parasites and affect many species of trees. The former two are particularly damaging to mango trees and they are all entirely bird distributed. In the valleys of North Salsette, bamboo (*Bambusa stricta* ?) is abundant, and though not studied in any ecological detail it is interesting to find that there are patches of forest of evergreen aspect (containing the lianas *Entada scandens* and *Gnetum scandens*) on the top of our highest hills. Larger patches of this type occur on Tūngār Hill across the Bassein Creek.

A large portion of the earth used in the surface filling of the Back Bay reclamation blocks was transported from Kandivli. Along with it came the seeds of many species of Salsette plants which, germinating after the first monsoon, rapidly colonised their new home forming little scattered thickets. With the growth of this vegetation, many birds that had heretofore found nothing to attract them in this locality found ample food and shelter and some, even congenial breeding sites. When the scrub is again cleared and the plots built upon or otherwise utilised, these new colonists will be forced to retreat once more. The Reclamation area, though small in extent, and partly indeed because of it, provides an admirable venue for the study of ecological succession.

General remarks on the Bird-Life.

Besides the resident avian population of Bombay and Salsette there is every year a heavy and conspicuous influx of migrants, which commencing often as early as August reaches its peak by about the middle or end of November. The birds either pass on farther south after a short stop-over—*passage migrants*—or linger in our midst throughout the cold weather months—*winter visitors*—but the vast majority are a mixture of these two classes, some individuals staying on in the locality while others continue their southward journey. With the approach of the hot weather, the migrational tide begins to ebb. The northward exodus commences about the end of February, and by the first week in May most true migrants have departed for their breeding grounds in the Himalayas or beyond into Central Asia and Siberia.

Apart from the true migrants, there is a host of species that move about locally within a more circumscribed range and which may be met with in our area at some seasons of the year but are absent at others. The abundance or paucity of food supply is certainly one of the causes that govern the movements of this class—*local migrants*—but what the other controlling influences may be we as yet know little. Rufous-backed Shrikes, for instance, are common in Salsette from about September to March but retire further inland thereafter, while Pittas and Pied Crested

Cuckoos usually make their appearance in our midst at the commencement of the monsoon for short periods. The study of local bird movements is a promising subject which may here be recommended to field naturalists in this and other parts of India.

There is yet a fifth class of birds that needs to be mentioned—the *vagrants*. Occasionally these are isolated individuals that have, for some unaccountable reason, strayed far out of their accustomed haunts. The Hypocolius—a Persian bird was recently shot at Kihim across the harbour; while at other times many species may be involved, all driven out of their normal habitat by exceptional and adverse natural conditions. Thus the drought in Gujerat and those parts during 1899 brought numbers of strange birds to Bombay for a living. A flock of 40 to 50 *Chettusia gregaria* appeared and remained for some weeks on the Esplanade where they naturally attracted much attention and were productive of letters in the local newspapers. The heavy gales at the commencement of the South-West Monsoon frequently throw up sea birds like Gannets and Shearwaters on our shores at that season.

Our avifauna does not fall into any well-defined zoo-geographical sub-region. The peculiar Indo-Malayan element of the South-West e.g. the frog-mouths, the spine-tails, the laughing-thrushes, the bazas and many others do not extend so far north. The great tide of Palaearctic migrants that sweeps into India through the North-West reaches and influences our bird-life to the extent to which it affects the Deccan in the same latitudes. But our affinities are not with the Deccan, except in so far as the common birds of India are the common birds of the table-land as well as of Bombay. In the first place we lack a stable and resident population of birds typical of the dry open plains, the sand-grouse, the bustard, the grey shrike, the Indian courser, the black-winged kite, the tawny eagle, various larks and others. But there is another difference that is not easily appreciated—the absence of resident counterparts of migrants like the rufous-backed shrike, the little ringed-plover and the hoopoe. The Western Ghats, of course, are next-door to us, and almost directly continuous with Salsette in the north. And from these Ghat forests our bird-life is enriched by such forms as the trogon, the orange minivet, the black-capped blackbird, the grey-fronted green pigeon, the racket-tailed drongo, and the Malabar whistling thrush. There are, of course, many Ghat species that we have not observed in Salsette, but the nature of the terrain and the presence of conspicuous forms, inclines us to the opinion that our bird-population approximates more closely to that of the hill ranges than of the table-land beyond.

Within the city of Bombay there are indeed few spots still left where one may enjoy the song or company of birds apart from the 'scum of the air'—the kites, crows, pigeons and sparrows—that have adapted themselves to a life of unabashed parasitism on Man and flourish in his midst and by his concerns. Nevertheless it is surprising what a number of other species have unobtrusively managed to acclimatise themselves to the changed and ever-changing conditions of urban life, and may still be met

SOME FRUITFUL SPOTS FOR BIRD-WATCHING IN SALSETTE.

1. View from Mullund Hills, looking east.

2. Trombay Hill (monsoon vegetation).

3. A corner of Tulsi Lake.

4. Tulsi Lake with Borivli Hills in the background.

Photos 1, 3 *and* 4 *by* *T. E. Waterfield.*

wherever the least bit of garden or shrubbery prevails, or even amongst our roadside trees. Tailor-birds will nest in a potted croton in the heart of the town, while sunbirds peering out of their pendant nests appear perfectly at home with trams and motor cars roaring past within a few feet of them. In the cold weather wagtails and pipits may still be seen on the various maidans busily hunting insects in among the maze of cricket-nets and the throngs of players, hawkers, loafers and pleasure-seekers, while swifts continue to occupy many of their age-long nesting sites under the porches and eaves of antiquated buildings, since beset by noisy thoroughfares.

The more spacious residential quarters of the town, however, with their gardens and large rambling compounds, as in the Malabar Hill area—unfortunately fast disappearing—are still amazingly rich in their avifauna. Government House grounds at Wālkēshwar form an ideal bird haunt and to this day harbour a number of species otherwise only met with further afield in Salsette. The Victoria Gardens at Byculla afford an island of refuge and a breeding ground to many species amidst an otherwise congested and uncongenial locality.

Apart from the actual deprivation of feeding grounds and nesting sites which has resulted directly from the development or occupation of new or erstwhile sparsely populated areas, the most serious menace that birds have had to reckon with has been, and continues to be, the advance hand in hand with these conditions of the 'boy' and the 'crow'. Both are unavoidable concomitants of urbanisation and both an equal nuisance to bird-life. The mortality in birds' eggs and young traceable to their joint and several depredations is appalling. We have known gardens in the City—then in remoter and less congested localities than now—where but a few years ago such birds as ioras and fantail flycatchers used to breed successfully year after year, but where only rarely in the course of several recent years were we able to observe families of the latter safely out of the nest. Even where they managed to survive the nestling stage, the young invariably vanished soon after, and from the marked attention they had been receiving from these vandals and from the stray cats of the neighbourhood, there seemed little doubt as to who was culpable. After several unsuccessful attempts of this sort, the birds finally deserted the localities presumably in search of less harried surroundings farther afield.

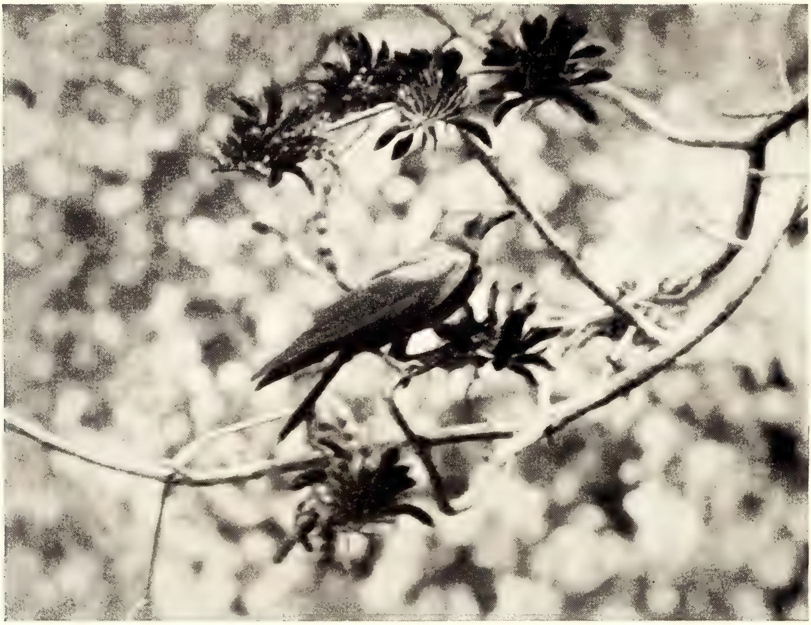
This example is typical of what is happening every day as population advances. Crows are inveterate nest-robbers and in the more populated areas where they abound as a matter of course, it is almost impossible for any eggs or young, especially in open nests, to escape their felony. As long as they go unchecked—and this is the *fiat* of our City Fathers—it is futile to attempt to encourage the smaller and more defenceless forms of bird-life into the precincts of our homes and gardens. Pernicious egg-taking by, and catapults and air-guns in the hands of idle thoughtless boys supplement the sorry work.

In the lesser populated suburbs of Bombay and the cultivated and wooded country in Salsette, however, bird-life has still a refuge which, with a little more of intelligent appreciation and a little less of apathy, it should still be possible to retain as a permanent sanctuary. Apart from the natural marauders—birds, beasts and reptiles—a considerable menace to bird-life in suburban areas is that all too familiar breed of local 'sportsmen' who scour the countryside, year in year out, equipped in red loin-cloth and smoking cap and armed with catapults or an ancient fowling-piece; who comb the jungles or prowl about the creeks and village tanks from crack of dawn to slay every living thing that will repay the expenditure of powder and shot. In its immature or 'catapult' stage this breed—Anton, Pascal, Dominic or what you will—is a scourge to small birds, their eggs and young. As imago it possesses knack of almost invariably managing to acquire a gun of sorts, thenceforth transferring its nefarious attentions to every slaughterable creature of the earth and of the air.

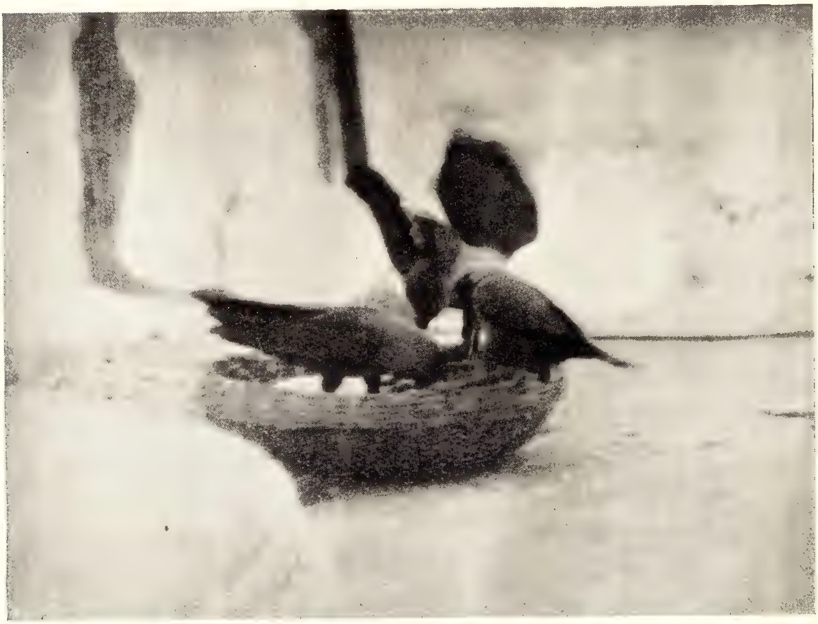
Inspite of these conditions, it must be admitted that in relation to its size the bird-life of Salsette is still tolerably rich both in species and in numbers. How long it will be able to hold its own in the face of these powers of disintegration without special protection and an awakening of the public conscience, depends largely upon economic prosperity which is bound sooner or later to complete the work it has begun—the building of Greater Bombay. Unless in the meanwhile the rising generation—the citizens of tomorrow—are taught by means of Nature Study in schools and by intelligently-conducted excursions into the countryside to take pleasure and pride in the bird-life and other natural objects around them, it is unreasonable to expect a change in their outlook or that they will extend the requisite facilities to birds and other creatures to live when this eventuality arises. It is a hackneyed commonplace that protective laws by themselves are impotent unless they have the backing of strong and well-informed public opinion, and there can be no doubt that the seed of public opinion is most effectively sown only in the classroom.

Some of the finest spots we know of in the neighbourhood of Bombay for the watching and enjoyment of birds are in the hilly wooded country between the Tūlsi Lake and the Gōdbunder Creek which forms the northern boundary of Salsette. Trombay, both the lower hillsides and the scrub country around the base of the hills is excellent, while Borivli, Kandivli and the locality about Kanhēri Caves will never fail to repay a morning's ramble. There are now good motor roads throughout Salsette, affording very pleasant and beautiful drives, and the efficient local services of the B.B. & C.I. and G.I.P. Railways bring all the wooded spots within easy and comfortable reach of all.

It is hoped that the publication of this paper will help to stimulate an interest in the bird-life that is fortunately still around us and lead to an appreciation of its true value as an aesthetic as well as an economic asset, and ultimately, to statutory and practical measures for its encouragement and preservation against the onward march of progress and conditions increasingly hostile to its continuance.



The Jungle Crow (*Corvus m. culminatus*).



House Crows (*Corvus s. splendens*) pilfering from a fishwife's basket.

Photos by *Sálim Ali.*

SYSTEMATIC LIST.

Family: CORVIDÆ.

The Southern Jungle Crow : *Corvus macrorhynchos culminatus* Sykes.

Local Name: *Dhobia Kaula.*

Field identification: Larger, heavier and more glossy jet black than the Indian House-Crow, and lacking its grey collar and breast. (Often erroneously called the 'raven' or the 'rook' neither of which occur so far south as our area.)

The Jungle Crow is rare within the limits of the city proper, but is a resident of suburban areas and the wooded portions of Salsette where it is fairly common and more or less completely replaces the smaller grey-necked species. It is omnivorous in its diet, but much more of a carrion-feeder than the last named, and may generally be seen at carcases of cattle in company with vultures. It is a great robber of the eggs and young of other birds and is fond of the land crabs that emerge from their aestivation so abundantly during the monsoon months. It is also partial to the nectar of the blossoms of *Erythrina* and *Bombax* trees and a regular visitor to them in season.

A peculiarity noted in this species is the short flights often indulged in with neck outstretched and wings held almost upright and back to back above the level of the body, the tips being flapped through a small arc and the bird cawing in a high-pitched key the while. This is presumably done under stress of some emotion which is usually but not always sexual.

Breeding: In our area the Jungle Crow is an earlier breeder than its grey-necked congener. We have found nesting activities in progress in every month from November (earliest date 26th) to June (latest date 14th), but chiefly between March and May. On 13 May a bird has been observed carrying sticks for a nest, while on the same date a full-fledged young with pinkish gape was on the wing.

The nests are the usual untidy platform-like structures of twigs often with an admixture of iron wire, with a cup-like depression in the middle lined with cocoanut fibre, tow, horsehair or any such soft material available. They are placed in Banyan, Mango or Tamarind trees usually between 20 and 30 ft. from the ground and frequently in the vicinity of villages and outlying huts. A favourite site in Salsette is at the base of the leaf-stalks of Tād (*Borassus*) palms, and many of such nests come to grief owing to the removal of the leaves for thatching purposes before the monsoon. Several other birds such as Swallow-Shrikes, Palm Swifts and Mynas must also suffer considerable mortality on this account.

We have found 4 or 5 eggs to be the normal full clutch in this locality. The Koel (*Eudynamis scolopaceus*) commonly parasitizes the nests of the Jungle Crow. We have never found more than a single young Koel in a nest and these in May and June.

On 9 September (Chembur) an extraordinary attachment to an old nest by a pair—presumably the same birds as had eggs in it on 25 May—was noted. The owners persistently kept in its proximity, cawed concernedly and showed much agitation when it was climbed up to although it was in a somewhat dilapidated condition and contained no eggs.

The Indian House-Crow. *Corvus splendens splendens* Vieill.

Local Name: *Kaula.*

The Indian House- or Grey-necked Crow is unquestionably the commonest and most ubiquitous bird in the city of Bombay and in the more densely populated of its suburbs. He is universally and perhaps justly reviled, but it is impossible to overlook his usefulness in keeping the city clean of refuse. However much one may resent his practices or deplore his morals, one cannot but admire his masterly finesse and cunning in invariably getting the better of his fellow-citizens, not excluding Man himself. Whether he is manoeuvring to deprive you of your *chota hazri* toast, or shadowing your movements to despoil a well-concealed nest as soon as your back is turned, there is in his tactics the same well-calculated shrewdness that places him without dispute in the front rank of avian intelligentsia.

The Crow is a born opportunist. His capacity for discrimination between a harmless person and one not to be trusted, and between a stick and a gun is truly uncanny. Climb up to his nest and handle the eggs or young and for weeks afterwards you will be singled out from among your fellows for special attention, even though you appear differently attired on each occasion. Execrations will be lavished upon you at sight and you will even be subjected to assault and battery at the bills of the outraged owners.

Much has been written about the Crow, but the subject is still far from exhausted. Indeed, as long as human ingenuity persists so long will the Crow continue to afford matter for study and amazement as he will continue to devise counter-measures to deal with any new situation that may arise in order that he may still get the better of Man and profit by his concerns.

In the matter of diet the Crow is omnivorous and not exacting. It is this that makes him a blessing—albeit a mixed one—to civic life, and confers on him the patronage and protection of our City Fathers. No species of garbage comes amiss to him and he seems to thrive on everything. But while being a staunch ally of our health authorities in the maintenance of an efficient sanitary standard on the one hand, he also helps to promote disease on the other. In Chaupati Road, S. A. once watched a crow hop into a milkman's shop while the owner was away in a back room. The bird sidled up and on to the rim of a vessel containing the stock-in-trade, already popular with the fly community of the neighbourhood, and inserting his head into it, took several long and refreshing draughts! As the bird had quite possibly been feeding the moment before on the entrails of a sewer rat, or maybe something still more gruesome, it is not difficult to imagine his potentiality for the dissemination of disease germs.

With all this, however, it must be said that Crows are cleanly birds outwardly, and punctilious about their toilet. They never miss the opportunity of a bathe and runnels of water or ornamental ponds such as there are in the Victoria Gardens always have their quota of regular bathers. We have also observed them frequently washing themselves by shuffling among the dense and dripping foliage of trees like *Gulmohor* or *Karanj* after a shower of rain.

They are amongst the regular habitues of *Erythrina indica, E. stricta* and *Bombax malabaricum* in bloom and revel in the nectar of the blossoms. Specimens shot off them show a considerable quantity of pollen adhering to their forehead and chin, and the birds undoubtedly play an important part in the cross-pollination of these flowers. Parties frequently indulge in hunting winged-termites as they emerge from the ground on monsoon evenings, often till well after dusk. The birds either post themselves on the ground near the hole and tick off the insects as they appear, or else launch aerial sallies after them from roof-tops and the like, often going through remarkable evolutions in the chase. We have seen one take a complete somersault—loop-the-loop—in the air! One of their favourite hunting grounds is fish-markets where they cause endless annoyance to the fish-wives, sneaking up to the baskets and pilfering from them, both on the ground and off the women's heads and just managing to keep out of their irate reach.

With a high wind blowing, numbers of these birds frequently indulge in aerobatics involving considerable agility, for no apparent reason except the mere fun of the thing.

Breeding: House-Crows breed abundantly within town limits and also about the local railway line, and all through the better populated suburbs. The season proper may be said to last from May to August, although in some years it may begin considerably earlier and last till about the middle of September. The earliest date on which we have observed a bird tugging at and breaking off a dry twig from a growing branch is 18 February (St. Xavier's College compound). On 21 February we have a record of a half-built nest in the Victoria Gardens and on the 23rd of the same month another was nearing completion in a roadside tree opposite the Royal Opera House. The earliest date for young we have is 9 May when two were being fed in a nest near the Andheri railway station.

During the season almost every roadside tree in the town holds a nest, often two or more. The locality about the B.B. & C.I. Railway line between Grant Road Station and Dadar seems particularly favoured, as also that in the neighbourhood of the docks. Here a large number of nests are composed more or less entirely of iron wire or scraps of hoop iron filched from the neighbouring goods yards. This propensity to utilise iron wire in the structure of the nests was responsible for great interruption and delays in the suburban electric railway service when it was first inaugurated in 1922. The engineers had reckoned without the Crow which soon discovered that the overhead brackets holding the power wires provided admirable nesting sites and took to them wholesale. The iron used in many of the nests caused short-circuiting and brought traffic to a standstill. Thus in one week 44 trains were held up, and it was with some difficulty that the cause was finally discovered. Not until a specially designed insulated or crow-proof bracket was introduced was this nuisance finally eradicated.

The nests are mostly placed in trees—Mango, Tamarind, *Albizzia, Casuarina, Polyalthea,* palms and others—from a height of about 12 ft. up, mostly between this and 20 ft. In structure they do not differ from those of the Jungle-Crow except that, owing to its greater availability in town, iron wire etc. is more employed in its construction. There is the almost classic example of a nest built entirely of gold and silver spectacle frames pilfered from an optician's shop in the Fort. About Rs. 400 worth of frames disappeared before the culprits were run to earth!

Three to five eggs are normally laid and the largest number of young we have seen in a nest is four. In our experience two is the largest number of young being tended by the parents out of the nest, and it appears that the mortality in the nestling stage is heavy. The Koel habitually foists its eggs on the nests of the House-Crow. On 9 (June 1931) H. A. found a nest with 11 Koel eggs of two different types which appeared to have been laid by two different females. There were no crow's eggs in the nest, but signs of a broken egg which may have belonged to the latter (*J.B.N.H.S.,* xxxv, 458). We have usually seen a single young Koel being tended by its foster-parents out of nest; only on one occasion two. Never have there been any young crows about, and it might be questioned as to what becomes of them and whether like the European Cuckoo the young Koel also heaves its foster-brothers over the edge of the nest.

Various stages of albinism have been noted and described in the House-Crow in and around Bombay city. One that occurs more frequently than others is the isabelline phase of which an example bred for two years at least in the Government Dockyard (1924 and 1925). For those who still believe in the popular notion that crows mate lying on the ground with their vents apposed, it may be mentioned that we have now observed them mating in the usual manner of birds—'treading'—a sufficient number of times to dispel this fallacy. Popular belief also credits the crow with exceptional longevity or even immortality. The argument advanced is that in spite of its abundance, one seldom comes across a crow that has died a natural death; a fact that is indeed true enough of most wild animals.

The Crow has few natural enemies and but for the heavy mortality in its nestling stage and other periodical checks, its numbers would soon become unendurable. A few years ago a mysterious disease appeared among the crow population of Bombay which evoked a good deal of correspondence in the local press at the time. Large numbers of adult birds were found lying dead in many parts of the city and suburbs, in a stiffened condition, beneath their perches. The Haffkine Institute investigated the matter but as far as we are aware without elucidating any clue to the mystery.

This account of the House-Crow has become inordinately lengthy, but there is so much of interest in the life of this pre-eminently urban bird that it could not be compressed further without doing him an injustice.

The Indian Tree Pie: *Dendrocitta vagabunda vagabunda* (Latham).

Field identification: 'A bright rufous magpie with sooty head and neck, and impressions of grey, black and white in the wings and tail' (Whistler, *Popular Handbook of Indian Birds*).

Specimens: *St. Xavier's College*: 134 ♀ 15-8-33 Powāi; 214 ♀ 13-12-34 Borivli (H. A.); *Bombay Natural History Society*: o? 16-3-24 Vihār Lake (S. A.).

Elsewhere noted: Chembūr, Trombay, Gōdbunder, Kandivli, Mulund, Thāna, Marōl.

Resident. The Tree Pie is fairly common in the better wooded portions of Salsette, frequenting lightly forested hillsides and occasionally also gardens and orchards in the suburbs. It is usually met with in noisy pairs or small parties of 4 or 5 birds. It has a large variety of calls, both harsh and pleasant, some of them being very similar to those of the Black-headed Oriole. It is very destructive to the eggs and young of small birds, and also feeds on lizards, young mice and grasshoppers and other insects. *Bombax* flowers are largely visited in season for their nectar. Mr. McCann informs us that he observed one in Salsette feeding on the ripe fruit of 'Kaundal' (*Trichosanthes palmata* Roxb.). This is strange since according to Roxburgh (Kirtikar and Basu, *Indian Medicinal Plants*, i, 580) the fruit is poisonous and, mixed with rice, is employed to destroy crows!

Breeding: We have not taken any nests in Salsette, but have seen three full-fledged young in company with one of the parents on 9 July.

Family: PARIDÆ.

[**The Southern Grey Tit:** *Parus major mahrattarum* Hartert.

Not in Salsette, but we have observed it on the adjacent mainland at Vāsind, Tānsa Lake, Kasāra, Igatpūri, Nāsik and elsewhere.

Breeding: Capt. Betham (*J.B.N.H.S.*, xii, 78) records it nesting in the neighbourhood of Poona in June and July.]

Family: TIMALIIDÆ.

The Bombay Rufous Babbler: *Turdoides somervillei somervillei* Sykes.

Malacocircus somervillei of EHA.

Local Name: *Khekata* or *Sāt-bhai.*

Specimens: *St. Xavier's College*: 11 ♂ 6-8-33 Marōl (H. A.).

Field identification: Untidy, earthy-coloured bird slightly smaller than Myna, with loose tail. In small squeaking flocks.

Noted: *Bombay and Salsette*: Government House Grounds, Wālkēshwar, Parēl, Dādar, Pāli Hill (Bandra), Andheri, Sion, Kandivli, Borivli, Malād, Gōdbunder, Mulund, Thāna. *Adjacent mainland*: Pārsik, Kihim, Alibāg, etc.

Resident. The Bombay Babbler is a common bird in the suburbs of Bombay and all through Salsette, as well as on the coastal portion of the mainland opposite. It frequents residential compounds, mango orchards and groves of trees in flocks or 'sisterhoods' of 6 to 8 birds, which rummage among the fallen leaves for insects. Some grain is also eaten while the ripe berries of *Lantana camara* are much favoured. The birds are invariably present on *Erythrina indica* and *E. stricta* in season—and also to a lesser extent on Simal (*Bombax*)—probing into the blossoms for the nectar. They do valuable service in cross-pollinating them.

Usually perfect amity prevails amongst the members of a sisterhood, but occasionally differences of opinion arise between individual members or between two separate sisterhoods, and desperate encounters ensue with much recrimination and flying of feathers. The whole flock rallies to the encounter engaging with members of opposing flocks, rolling on the ground interlocked and plying viciously with bill and claw. The battles are of short duration, however, and it is not long before harmony is restored.

Babblers may frequently be seen shuffling themselves and bathing among the dripping foliage of a bushy tree after a shower of rain. This appears to be a common bird habit. We have seen White-throated Babblers and several other species doing the same, besides Crows which, as mentioned before, indulge in it freely.

Breeding: This Babbler evidently breeds irregularly throughout the year. We have found nests in various stages of building or with eggs and young and also immature birds of all ages (never more than two with a pair) in almost every month, but principally between April and November. Barnes (*J.B.N.H.S.*, iv, 245) found it breeding at Sion in June and July.

The flocks do not break up at any time, but breeding pairs detach themselves occasionally for their domestic duties, though continuing to feed in company.

The nest is rather an untidy shallow cup of fine twigs and rootlets. It is flimsy in structure and the contents or sky can usually be seen through from underneath. It is placed in the fork of mango—especially bushy grafts—*Asūpāl* (*Polyalthea*), and similar densely foliaged trees at between 7 and 30 ft. from the ground, but most often under 15 ft.

The full clutch consists of 3 to 4 beautiful greenish-turquoise eggs.

The Pied Crested Cuckoo commonly foists its eggs on the nest of this Babbler. Eha (*N. & E.*, i, 80) records a pair followed by a young one and a young cuckoo at Bombay, and we have observed the manoeuvres of this cuckoo in its cuckolding quest at Kihim (26 August 1930).

The Common Babbler: *Argya caudata caudata* (Dumont).

Field identification: Small brown bird, boldly streaked above, and with long loose graduated tail. 'Looks like a miniature hen pheasant in flight' (Whistler). Size about that of a bulbul.

Specimens: *St. Xavier's College*: 72 ♂ 8-9-33 Gōrēgāon; 86 ♂ 25-9-33 Jūhū (H. A.).

Noted: Andheri, Bassein; 8 miles from Thāna on Poona Road.

Resident. The Common Babbler is very rare in Salsette, as it is on the coastal strip of the adjacent mainland. It inhabits dry open scrub country. It has not been observed by us in the neighbourhood of Kihim (Kolāba District) at all during the course of several years watching.

Breeding: From the condition of their gonads both the specimens (8 and 25 September) were evidently breeding. The testes of the former were enlarged to 15×10 mm. On 25 April (1935) a pair was observed accompanied by two juveniles just out of nest on a small scrub-covered hillock at Andhēri where a sisterhood of 6 to 8 birds is known to be resident.

The breeding season here is apparently as ill-defined as it is in other parts of its distributional range.

The Deccan Scimitar Babbler; *Pomatorhinus horsfieldi horsfieldi* Sykes.

Field identification: A dark-coloured skulker, usually in dense forest or bamboo jungle, with a curved yellow beak and a prominent white eye-brow. Size slightly larger than Bulbul.

Specimens: *Bombay Natural History Society*: o? 2-8-25 Kandivli; ♂ (607. 9-9-28) Hills on Thāna-Gōdbunder Road (S. A.). *St. Xavier's College*: 170 ♀ 19-11-33 Borivli (H. A.).

Noted: Gōdbunder and the wooded hills in North Salsette; Parōl Pāra and Salāo (Kolāba District); Ghāts (Mahābleshwar, Panchgani, Khandāla, etc.).

As pointed out by Messrs. Kinnear and Whistler (*J.B.N.H.S.*, xxxv, 742) birds from our area are really intermediate between the large pale race with a long beak—*P. h. obscurus*—from the north-western portion of the range of this species, and the richly-coloured race from the south-west—*P. h. travancoreensis*. Our specimens have practically no trace of the rufous tinge on the back, and in this particular approximate more closely to the latter form.

Resident. The Scimitar Babbler is not uncommon in the well-wooded northern parts of Salsette. It is partial to bamboo patches and low dense bush jungle on the hillsides. The birds usually move about in small scattered flocks of 4 to 7 individuals and are very shy, keeping to the seclusion of thick cover and seldom showing themselves. Their mellow gurgling 'whistles' however invariably give away their presence in any locality, and they can be decoyed long distances by an imitation of their calls. Their food consists largely of insects which are picked off the branches and trunks of trees as well as rummaged for among fallen leaves in typical babbler fashion.

'An unidentified Cuculus (*C. micropterus*?) reproduces the call of this species to perfection' (H. A.).

Breeding: We have no information concerning its breeding in Salsette, but elsewhere in its range it is said to do so between January and May.

The White-throated Babbler; *Dumetia hyperythra albogularis* (Blyth).

Field identification: A small bird of a light brown colour, and a pure white patch on the throat. Size about that of a sparrow.

Specimens: *Bombay Natural History Society*: o? 7-6-25, o? 14-6-25 Chembūr (S. A.); o? juv. 23-9-28 Vehār, o? ad. 30-9-28 Vikhrōli (McCann). *St. Xavier's College*: 51 ♂ 19-8-33 Gōrēgāon (H. A.).

Noted: Government House Grounds (Malabar Hill), behind Gaikwar's Palace (Nepean Sea Road), Somerset Lodge grounds (Warden Road), hills on Thāna-Gōdbunder Road, Andhēri, Jogēshwari, Mulund, Powāi; Kihim, Alibāg and elsewhere in Kolāba District.

Resident. In 1926 (July) S. A. found this little Babbler quite common in the jungly undergrowth of bushes and scrub on either side of the main drive through Government House grounds by the Wālkēshwar Road entrance. The environment in this secluded locality was eminently suitable for this species, and we suspect that the birds seen at the only two other places within town limits subsequently were stragglers from the colony resident here. We have no more recent information concerning the grounds. Possibly there may be other rambling compounds in the Malabar Hill area still capable of affording refuge to the species for some time longer.

In the northern part of Bombay island and all through the scrub and wooded country about the foot of the hills in Salsette, the White-throated Babbler is not uncommon. It is usually met with in flocks of 10-12 birds which hop about restlessly amongst tall grass stems and undergrowth, or on the ground below, in search of insects. The members keep up a low 'cheep-cheep' or 'swee-swee' of about the volume of a sunbird's calls, varied occasionally by harsher twittering notes, especially when agitated.

We have frequently observed them feeding on nectar from the flowers of *Erythrina indica* and *E. stricta*, two common trees in Salsette.

Breeding: The breeding season proper in this area commences in the latter part of June after the rains have well set in and the luxuriant growth of monsoon vegetation is up. It lasts till September, but the best time is undoubtedly till the beginning or middle of August. We have records of nests in various stages as follows: 4 July ('32) Andhēri; 18 July ('26) Government House grounds (Malabar Hill); 30 July ('35) Mulund; 20 September ('25) Chembūr.

On 29 August ('26) a three-quarters grown young in loose juvenile plumage and stub tail was observed with parents at Chembūr, while the specimen collected at Vikhrōli by Mr. McCann on 23 September ('28) was one of a party of 3 juveniles lately out of nest.

The nest is a neat ball-shaped structure about 6 in. in diameter, composed on the exterior of coarse grasses or bamboo leaves with the entrance hole on one side. It is lined with finer grasses. Eha (*C.B.B.*, 85) writes of one he found in a Bombay garden that was made of the curly paper shavings used in packing eau-de-cologne bottles.

It is usually placed from 3 to 6 ft. from the ground in a 'Ber', *Ixora* or other thorny bush, often overgrown with monsoon creepers. Humayun Abdulali found one at the base of the leaf-stalks of a small date palm at a height of about 3 ft.

Three to four eggs is the normal clutch. They are white in ground colour, spotted and blotched all over with reddish-brown.

The nests from 'Tanna and Khandalla' recorded by Wenden (*J.B.N.H.S.*, iv, 241) as belonging to *D. h. hyperythra* doubtless were of this form.

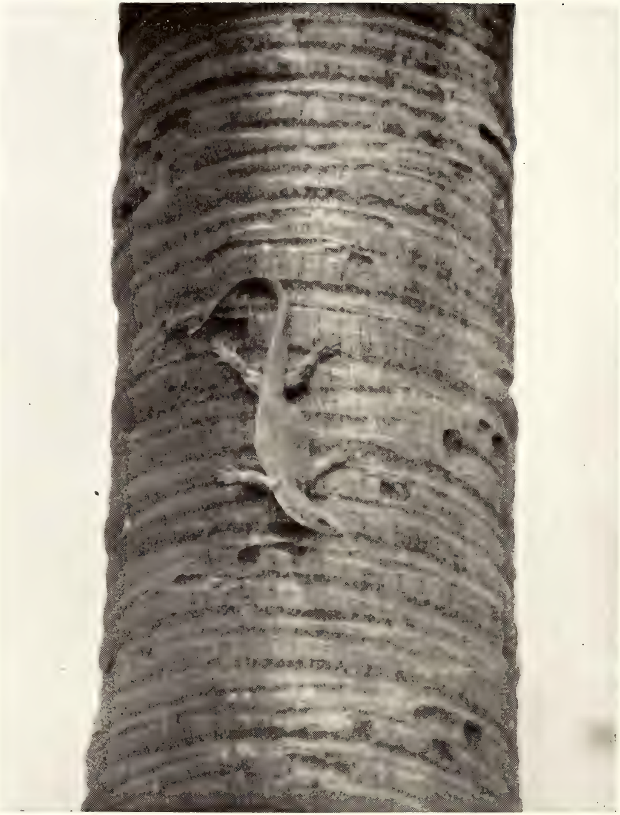
The Yellow-eyed Babbler: *Chrysomma sinensis sinensis* (Gmelin).

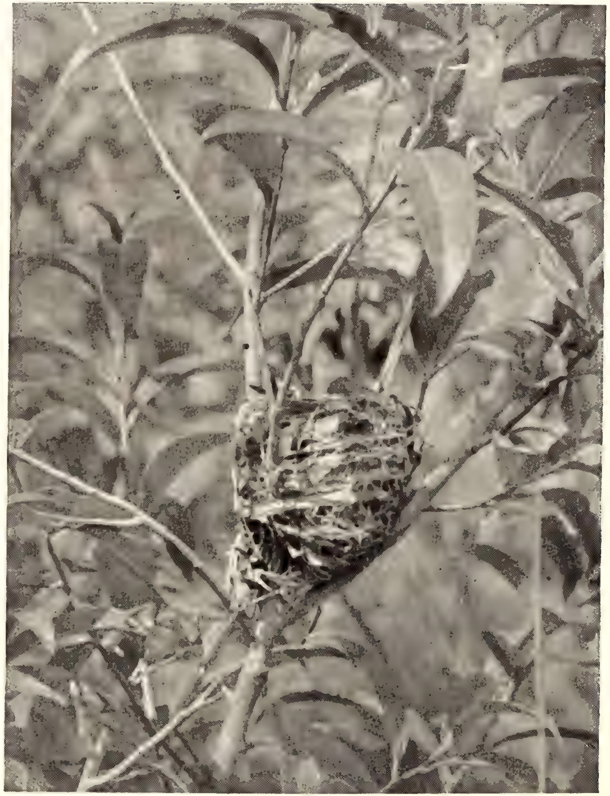
Field identification: 'Small rufous bird with white under parts and a rather long full tail; orange eyelids are conspicuous' (Whistler).

Specimens: *Bombay Natural History Society*: o? 21-3-24, o? 14-6-25, ♀ 17-11-27 foot of Trombay Hills, Chembūr (S. A.). *St. Xavier's College*: 68 ♂ 8-9-33 Gōrēgāon (H. A.).

Noted: Kandivli, Borivli, Kanhēri Caves, Mulund, Powāi, Trombay, Thāna-Gōdbunder Road, Pārsik etc.; Kihim and elsewhere in Kolāba District; Nāsik.

Resident. We have not come across this Babbler within the limits of the city proper, but it is common in scrub jungle about the suburbs and in Salsette generally. It goes about in small parties of 4 or 5, hunting among the bushes and grass stems for insects and occasionally clinging upside down in the manner of a tit. The note usually uttered is a clear, loud and somewhat plaintive 'cheep', but sometimes—and frequently during the breeding season—the males clamber up to exposed situations and utter a loud and pretty song. These Babblers are amongst the usual habitués of the Coral tree (*Erythrina*) in season, and feed extensively on the nectar of its blossoms.





Photos by *Sálim Ali.*

Circumstantial Evidence! A Monitor Lizard descending Palmyra palm containing Myna's nest. Chembūr, Aug. 1927.

Nest of the Yellow-eyed Babbler (*Chrysomma s. sinensis*). Note owner crouching within.

Breeding: The breeding season is during the rains, principally from July to September. We have records of the following nests: 9 July ('28) Powāi; 18 July ('35) Trombay; 5 August Powāi; 29 August ('26) Chembūr; 9 September ('28) Hills on Gōdbunder-Thāna Road; 22 October ('33) Kihim.

N. & E., vol. i, p. 97, mentions a clutch of 5 eggs taken on 10 October and a nest with 3 chicks and 1 egg on 30 October at Igatpūri.

The nest is a beautifully built deep cup of coarse grasses lined with finer material and is usually sparsely to moderately cemented on the outside with cobwebs. It is hung hammockwise between the upright stems of grasses or monsoon plants, or wedged into some crotch of a bush, from 18 in. to 4 or 5 ft. from the ground. The supporting stems or twigs are incorporated into the wall of the nest which is sometimes carefully concealed and at others absurdly conspicuous. When approached closely, the incubating bird slips off the nest, but skulks away through the undergrowth for some distance before taking to wing. It returns to the nest in the same circumspect manner.

The cup is so deep that the contents are seldom visible unless looked at from directly above. When incubating—especially when crouching low at the approach of an observer—all that can be seen of the bird is its beak sticking obliquely up at one end of the nest and its tail at the other. The eye peers just over the rim and surreptitiously follows the movements of the intruder.

Four eggs comprise the normal clutch in our area. They are fairly glossed yellowish-white in ground colour (with a pinkish tinge when fresh) and finely speckled with purplish-brown. . . . In shape they are roundish oval and measure about 17×15 mm.

Both sexes incubate and feed the young. The period of incubation has not been determined, but the young leave the nest 12 or 13 days after hatching.

The Spotted Babbler; *Pellorneum ruficeps ruficeps* Swainson.

Field identification: Small fluffy olive-brown bird, usually skulking in undergrowth, on or near the ground running about like quail; a reddish-brown cap; whitish under-parts with breast heavily streaked. Size little larger than a sparrow.

Specimens: *Bombay Natural History Society*: 3 juveniles 16-9-28 Hills near Gōdbunder (S. A.); ♀ 1-1-09 Andhēri, ♂ 22-9-12 Borivli (N. B. Kinnear). *St. Xavier's College*: 35 ♂ 16-7-33 Powāi, 44 ♀ 23-7-33 Kanhēri, 98 ♀ 28-9-33 Borivli (H. A.).

Noted: Mulund; Kihim, Parōl Pāra, Mahābleshwar and other wooded localities in the Thāna, Kolāba and Satāra Districts.

Resident. The Spotted Babbler is not uncommon in the well-wooded hilly portions of Salsette. The birds are seen singly or in pairs, skulking in thick undergrowth or rummaging among fallen leaves on the ground in search of insects. They walk or run along the ground like quail, but also proceed by long hops in the typical 'seven sisters' manner. The birds are usually shy and retiring, but curiously enough they are remarkably tame at Kihim where they commonly keep about the hedges in the village and its precincts, sometimes even entering the verandahs of tenanted dwellings. The usual call-notes have often been likened to a plaintive '*Pret-ty sweet*'. They have also been rendered elsewhere as '*He will beat you*', '*He'll beat you*' or merely '*He'll beat*'. These are repeated every two seconds or so for quite ten minutes or more at a time. Besides, it has a loud and percussive song of several whistling notes rambling up and down the scale, and more frequently heard during the breeding season. It is uttered from some elevated perch. The alarm call is a loud '*kraa, kraa, kraa*' etc. with the throat feathers bristling.

Breeding: We have not taken the nest of this species in Salsette but the breeding season here seems to be the monsoon. The three specimens collected on 16 September were juveniles, lately out of nest, and juveniles in company with parents have also been observed on 30 August at Kihim, and one rescued from village urchins on 3 September. The number of young usually accompanying parents is 3 or 4.

The nest is a rough globe-shaped structure of grass and leaves placed on the ground under the shelter of a stone or bush.

As pointed out in the Hyderābād State Ornithological Report (*J.B.N.H.S.*, xxxvi, 379) the statement on p. 238 of the *Fauna* (vol. i) that this Babbler apparently does not breed below about 2,000 ft. is erroneous. Kihim is on the sea-coast and the whole of Salsette is also well under that elevation, but there is no doubt as to the species breeding in these localities.

The Bombay Quaker Babbler; *Alcippe poioicephala brucei* Hume.

Field identification: A rather slim babbler, with the usual nondescript olive-brown plumage and a grey cap. Size about the same as last.

Specimen: *Bombay Natural History Society*: ♂ 20-11-27 Kandivli (McCann).

Noted: Hills near Tūlsi Lake; Parōl Pāra (Alibāg Talūk), Rōha (Kolāba District); Mahābleshwar, etc.

Resident (?). The Quaker Babbler is rather rare in Salsette and confined only to the well-wooded hills in the north of the island, where we have come across it sporadically and sparingly. It is essentially a bird of wet forest of secondary aspect and as such, much more common at Mahābleshwar and in areas of heavy rainfall on the Ghats.

The birds move about restlessly in flocks of 5 or 6 individuals among the foliage of tall trees as well as in bushy undergrowth, hunting for insects. Two or three such flocks may frequently be seen together and in association with other avian species. The males have a pretty trilly whistling call or 'song' of 4 notes, of the consistency of a Magpie-Robin's, which is constantly uttered and is usually the first intimation of their presence in any locality.

Breeding: We have no information as to whether this Babbler breeds in Salsette.

The Central Indian Iora; *Ægithina tiphia humei* Stuart Baker.

Iora zeylonica of EHA.

Local Name: *Cheroka*.

Field identification: Male in breeding plumage 'a black and yellow bird about the size of a tomtit. The top of its head, with all its back and upper parts, is as black as a newly-brushed boot, with a white band across the wings . . . the whole under parts, from chin to tail, are a bright gamboge yellow' (Aitken). In the female the black is replaced by greenish-yellow. The male in winter loses much of the black and is then very similar to the female.

Specimens: *Bombay Natural History Society*: ♀ 7-2-24 Pāli Hill (Bandra) (S. A.); ♂ (No. 208.31-12-07) 26-3-99 Trombay Island (Major H. J. Walton); ♂ (No. 1376.31-12-07) 27-11-99 Hog Island (E. Comber). *St. Xavier's College*: 23 juvenile 6-7-33 Gōrēgāon (H. A.).

Noted: *Bombay city*: Khētwādi and Girgaum (1914); Chaupāti, Malabār Hill, Victoria Gardens, Fort, Colāba, etc. *Suburbs and Salsette*: Bandra, Santa Cruz, Khār, Andhēri, Borivli, Kandivli, Chembūr, Thāna, Powāi Lake, Mulund, Bhāndūp, Gōdbunder, Elephanta Island and on adjacent mainland. More or less ubiquitous.

Resident. The Iora is a common and familiar bird both within the limits of the city and suburbs and also farther afield. It frequents gardens, mango orchards and secondary jungle usually in pairs which hunt for insects among the foliage of trees, the birds keeping in touch with each other by mellow whistles and short musical chirrups. The nuptial display consists of the male chasing the female about impetuously from branch to branch and tree to tree, posturing before her with wings drooping, rump feathers arched and fluffed out and tail slightly cocked, to the accompaniment of chirruping notes, a variety of musical whistles or a long drawn '*chee-ee*'. Another very familiar and spectacular turn in the display consists of the male springing perpendicularly from a branch several feet up into the air, hovering, fluffing out and exhibiting his white rump feathers and parachuting down like a fluffy ball.

Breeding: We have taken or seen nests in the city and suburbs at Khētwādi (1913), Malabār Hill, Andhēri, Bandra, Chembūr, Borivli and elsewhere, too many to enumerate.

The season in our area and on the adjacent mainland is from May to September, our earliest date being 5 May and latest 4 September. July and August is the best time for eggs. The normal clutch here is almost invariably of three eggs, but sometimes—probably in the case of second layings—two are found.

The nest is a beautiful compact cup of fine grasses or fibres, well and neatly plastered over with cobwebs. It is placed in a crotch of twigs from 4 to 30 ft. from the ground, but oftenest between 6 and 12. Either the supporting twigs and leaves are worked into the wall or firmly wound round with cobwebs. Mango, *Bauhinia,* Lime (*Citrus*) and Ber (*Zizyphus*) trees are largely favoured.

The eggs are pale pinkish-white, blotched with purplish-brown and measure about 17·5×14 mm.

Both sexes partake in building the nest, incubation and tending the young. The nest in one case took five days to build and there was a pause of a day before the first egg was laid. The eggs are laid at intervals of about 24 hours and—as far as we have been able to ascertain—only early in the mornings. Incubation commences from the first egg, both sexes brooding more or less alternately, but it is fitful and irregular (even in wet weather) until the full clutch is completed. We have only found the female brooding at night.

The number of eggs and young of the Iora that come to grief is appalling. Within town limits the chief culprit is the House-Crow, with the Boy a good second. In the suburbs and outlying parts of Salsette, Jungle Crows, Crow-Pheasants, snakes, monitor and *Calotes* lizards do considerable destruction.

The Malabar Gold-fronted Chloropsis ; *Chloropsis aurifrons frontalis* (Pelzeln).

Field identification: Similar to the next, but with the forehead touched with bright gold. The chin is black in adults of both sexes, but pale green in the young.

Specimens: *Bombay Natural History Society*: ♂ ♀ 28-11-27 Mulund Hills overlooking Tūlsi Lake (S. A.); ♂ 22-10-28 Tūlsi Lake (McCann). *St. Xavier's College*: 7 ♂ 23-7-33 Tūlsi Lake (H. A.).

Noted: Kandivli, Gōdbunder, Kihim, Rōha, etc. (Kolāba District).

Resident. The Gold-fronted Chloropsis or Green Bulbul is fairly common in the better wooded parts of the island, especially in the environs of the three lakes in Salsette which furnish the city's water supply. It is thoroughly arboreal in its habits, and hunts systematically among the foliage of trees for insects, clinging upside down and in all manner of acrobatic positions in the search. Being of a grass green colour and harmonizing admirably with the surrounding leaves, it is oftener heard than seen, but even so it is such an accomplished mimic of the calls of other birds that it frequently passes for them and is overlooked. We have heard it imitating to perfection the following species: Tailor-bird, Red-whiskered Bulbul, the defiant Shikra-like notes of the Black Drongo, Iora, White-breasted Kingfisher, Rufous-backed Shrike and several notes of the Magpie Robin. The calls are often very puzzling since they are produced long after the originals have left the locality on seasonal migration, a fact which postulates a remarkably retentive memory on the part of the mimic. The different impersonations follow one another in quick succession without a break, and convey to the hearer an impression that a plenary session of a veritable avian League of Nations is in progress! On approaching the tree from which this Babel emanates, a solitary Chloropsis or a pair fly out and the illusion is at an end. Its own call or 'song' of several notes is wedged in between the imitations.

Insects and spiders form a large part of the diet of this Chloropsis, but berries are also eaten and the nectar of many flowers is regularly imbibed. We have observed it in this quest probing into the blossoms of *Erythrina, Bombax* and *Calycopteris floribunda.*

The adult female shot on 28 November had less and duller orange on the forehead and the blue cheek- or moustachial-streaks somewhat less defined, but the chin and throat were black and not pale green as have been described for this sex in the *Fauna* (i, 348). The latter description in reality applies to first winter birds of both sexes as pointed out by Messrs. Whistler and Kinnear (*J.B.N.H.S.,* xxxv, 752).

Breeding: We have no data in regard to the breeding of this species in Salsette.

Jerdon's Chloropsis : *Chloropsis jerdoni* (Blyth).

Phyllornis jerdoni of EHA (who appears to have confused it with *aurifrons*).

Field identification: A beautiful grass green bird with the chin black in the male and blue in the female. Size about that of a Bulbul.

Specimens: *Bombay Natural History Society*: ♂ 20-12-23 Andhēri (Prater); ♀ 22-3-24 Gōdbunder (S. A.). *St. Xavier's College*: 6 ♂ 27-7-33 Borivli (H. A.).

Noted: Kandivli (Salsette), Kihim, Parōl Pāra, Rōha, etc. (Kolāba District).

Resident. A fairly common species in Salsette and a bird of somewhat opener country than the last, frequenting mango orchards, gardens, groves of trees and thin forest.

It is also an excellent mimic and there is not much in its voice, habits or food to distinguish it from its Gold-fronted congener. On Coral trees in bloom, where it is a regular habitué, it plays the blustering bully, attacking and driving away every other bird feeding on the nectar not only in its immediate vicinity, but often a good distance away in another part of the tree. Sometimes we have even observed it acting dog-in-the-manger and driving away birds from the flowers by swooping down on them repeatedly from a neighbouring tree to which it returned after each sortie.

On one occasion (8 September 34) Humayun Abdulali observed a pair capturing (and eating) red ants (*Œcophylla smaragdina*) on a mango branch. Every ant caught in the beak was quickly but deliberately rubbed into the tail feathers before being swallowed. Humayun Abdulali speculates that this process may help to wipe off the unpalatable formic acid from the squeezed victims. A separate note on this interesting observation has been published by Sálim Ali elsewhere in this *Journal*. (vol. xxxviii, pp. 628-31).

Breeding: We have not been able to obtain any first-hand evidence, but EHA (*C.B.B.*, 93) has taken a nest and thinks that March and April is the usual season here. It is said to be a loose cup-shaped structure placed at the end of a branch of some large tree. Two or three white eggs with claret coloured spots are laid.

The Grey Hypocolius: *Hypocolius ampelinus* Bonap.

Specimen: *Bombay Natural History Society*: ♂ 14-11-30 Kihim (Kolāba District).

Vagrant. The normal habitat of this bird is Persia and along the shores of the Persian Gulf. The record of its occurrence in our neighbourhood is an exceptional one, there being altogether not more than two or three others for the whole of the Indian Empire.

Further particulars regarding the specimen will be found on page 1061 of volume xxxiv of this *Journal*.

FAMILY: PYCNONOTIDÆ.

The Red-Vented Bulbul: *Molpastes cafer cafer* (Linnaeus).

Pycnonotus haemorrhous of EHA.

Field identification: 'Cheerful smoky brown bird, with its face and fine crested head glossy black. The "under-tail coverts" as they are called in polite society are crimson' (EHA).

Specimen: *St. Xavier's College*: 9 ♂ 22-1-33 Andhēri (H. A.).

Noted: *Bombay City*: Warden Road, Malabār Hill, Government House grounds, Khētwādi and Girgaum (1913), Chaupāti, Victoria Gardens, Willingdon Sports Club grounds and elsewhere. *Suburbs, Salsette and adjacent mainland*: Pāli Hill, Bandra, Khār, Trombay Hills, Chembūr, Powāi Lake, Borivli, Gōdbunder, Thāna, etc.; Kihim, Ūran, Alibāg, Elephanta Island and elsewhere in Kolāba District.

Resident. The Red-vented Bulbul is a common and familiar species of gardens and residential compounds, both within city limits and in the suburbs. It also frequents the low country in Salsette generally, being less common in the hills where its Red-whiskered congener more or less replaces it. Along with numerous other bird species, it feeds largely on the nectar of flowers especially *Erythrina* and *Bombax*. We have also observed it nipping open the explosive buds of *Loranthus scurrula* and *L. longiflorus*, probing into them for the nectar and transporting quantities of pollen on its forehead.

Among the berries commonly eaten and for the seed dispersal of which this and other Bulbuls are undoubtedly largely responsible in our area, may be mentioned *Lantana camara*, *Streblus asper*, *Mimusops hexandra*, *Vitis* sp., *Flacourtia montana, Jasminum malabaricum* and *Loranthus* spp. Some insects are likewise taken. Flying termites are greatly relished and we have also seen several birds hopping about on the ground picking up small black ants emerging with their eggs from a hole.

Breeding: We have taken or seen nests, too numerous to detail, between the end of April and the beginning of October. The nest is a cup of rootlets with sometimes a little cobweb on the outside, placed at heights between 3 and 30 ft. from the ground but oftenest under 10 ft. The site selected is usually shrubs, creepers in verandahs, stunted date palms, cactus hedges, Ficus sprouts in wells or old walls etc. A particularly favourite site on the coast is the pollarded Bhendi (*Thespesia*) trees, and pruned Guava grafts in gardens seldom fail to attract the birds.

The normal clutch in these parts consists of two or three eggs which are pinkish-white in ground colour, more or less profusely blotched with purplish-brown or claret. There is considerable casualty among the nests due to rain, wind, etc., and the mortality among eggs and nestlings is heavy—lizards, snakes, crows, crow-pheasants, koels and boys being some of the agents that contribute to it.

The eggs are laid early in the mornings at intervals of about 24 hours. Incubation commences with the first egg as a result of which there is a marked disparity between the sizes of the chicks in the nest.

The White-eared Bulbul: *Molpastes leucogenys leucotis* (Gould).

Sind or Persian Bulbul of EHA.

Field identification: General appearance like the last, but with the cheeks white and the patch of crimson under the tail replaced by sulphur yellow. Size same as last.

Specimen: *St. Xavier's College*: 8 ♂ 16-8-33 Gōrēgāon (H. A.).

Noted: Vikhrōli (Salsette); Rēwas (Kolāba District).

Status uncertain, but apparently a recent immigrant and fast establishing itself as a resident. Our impression is that this bird, first reported to us by Mr. C. McCann in 1928 as a surprise straggler in our locality, has since been on the increase—though very gradual (see *J.B.N.H.S.*, xxxvii, 221). They are either descendants of escaped cage birds that have established themselves and multiplied, or represent a southward extension of range from Gujerat where the species is common, or both these factors operating together.

'In Salsette and across the Harbour, at Rēwas, they are always seen associated with *Clerodendron inerme* and *Salvadora persica*. As these plants do not grow far from mud-flats, the birds are also seen in similar terrain. The same association was also observed at Cambay (Gujerat) where the bird is common.' (H. A.)

The Southern Red-whiskered Bulbul: *Otocompsa jocosa fuscicaudata* Gould.

Local Name: *Inglees Bulbul* or sometimes *Mahābleshwar Bulbul.*

Field identification: 'Sprightly bird . . . dark brown above, white below, with a white patch on the cheeks, and a broken gorget across the breast; a crimson tuft below the eye and a similar patch of colour under the tail' (Whistler). It has a perky crest often likened to Mr. Punch's cap. Size same as last.

Specimens: *Bombay Natural History Society*: o? 16-3-24 Vihār Lake (S. A.). *St. Xavier's College*: 69 ♂ 8-9-33 Gōrēgāon (H. A.).

Noted: Warden Road, Malabār Hill; Pāli Hill—Bandra; Powāi Lake; Chembūr, Trombay Hills, Borivli, Kandivli, Andhēri, Gōdbunder, Thāna, etc.; Kihim, Alibāg and elsewhere in the Kolāba District and also in the surrounding country.

Resident. The Red-whiskered Bulbul is easily the commonest bird in the hills of Salsette where the jungle has been cleared and dense scrub (mainly *Lantana camara* and *Holarrhena antidysenterica*) has taken its place. Within city limits and in the suburbs it is less abundant than the Red-vented Bulbul.

It is of a tame and confiding disposition and in food and habits closely resembles the last-named.

It seems remarkable that such a keen naturalist and observer as EHA should have fallen into the error of saying about this bulbul (*C.B.B.*, 89) that:

'. . . the cheeks (or ears) of the male are crimson and those of the female pure white'. This, of course, is incorrect as the adult sexes are indistinguishable in appearance, both having the red 'whiskers'. In young birds, however, the red whiskers are lacking and the undertail coverts are a pale orange-rufous or salmon colour.

Breeding: The breeding season in our area lasts from March to October, and we have records of numerous nests during these months.

The nest is similar to that of the Red-vented Bulbul and placed in bushes, hedges or small trees generally from a few inches to within 7 or 8 ft. of the ground. Occasionally the site selected is the thatch or palm-leaf walls and roofs of tenanted huts, the birds sitting complacently on their eggs or feeding the young within a few inches of the inmates. The normal clutch consists of two or three eggs which are similar in colour and markings to those of the Red-vented species. The period of incubation is 15-16 days. Two, or sometimes even three, broods are frequently reared or attempted in succession, the casualty among the eggs and young being amazingly heavy.

Both birds share in the construction of the nest, rearing of the young and presumably also in incubation. The nest takes three or four days to complete and there is usually a pause of a day—sometimes two—before the first egg is laid. The eggs are laid at intervals of about 24 hours and early in the morning i.e. approximately between 6 and 7-30 a.m. Brooding sometimes commences fitfully from the first egg, but the nest is left unattended through long periods of the day and during night until the full clutch has been laid. Incubation is taken up earnestly thereafter though in the early stages it is often very intermittent during the day.

Although strictly speaking outside the scope of this paper, a distributional peculiarity of the Red-vented and Red-whiskered Bulbuls in a neighbouring area of the adjacent mainland is perhaps here worthy of note. The distance between Mahābleshwar (4,500 ft.) and Panchgani (4,400 ft.) on the Western Ghats is about 10 miles, yet the average annual rainfall at the former is between 225 and 275 inches while the latter receives only about 60 inches, both during the South-West Monsoon. The Red-whiskered Bulbul is one of the commonest birds about Mahābleshwar as is the Red-vented species at Panchgani, either to the more or less complete exclusion of the other. About two miles from Lingmāla Falls towards Panchgani stretches the almost sword-cut line of demarcation between the zones occupied by the two species and along this may also be said to lie the boundary between the evergreen vegetation of the humid, heavy-rainfall area of Mahābleshwar and the drier, deciduous country as about Panchgani.

The status of the Bulbuls in these two popular hill stations is so remarkable that it cannot fail to strike even a casual observer.

The White-browed Bulbul: *Pycnonotus luteolus luteolus* (Lesson).

Ixos luteolus of EHA.

Local Name: *Khar-bulbul.*

Field identification: 'A clumsier bird than the other bulbuls, uncrested and clad in an unaesthetic garb of brownish-greenish olive, passing into dusky greenish-yellowish white on the under parts. There is no bright colour about it, but its eye-brows are conspicuously white. A loud, abrupt, rattling snatch of a song.' (Eha). Size as of the Red-vented Bulbul.

Specimens: *Bombay Natural History Society*: o? 8-3-24 Pāli Hill—Bandra (S. A.); (No. 604.3-7-28) 22-6-28 Malād (E. Henricks). *St. Xavier's College*: 10 ♂ ?-8-33 Gōrēgāon (H. A.).

Noted: Warden Road, Cumballa Hill; Pherozesha Mehta Gardens and Government House grounds, Malabār Hill; Haffkine Institute grounds, Parēl; Khār, Andhēri, Trombay Hills, Chembūr, Borivli, Kandivli and elsewhere in Salsette; Ūran, Kihim, Alibāg, etc. across the Harbour.

Resident. This bulbul is common in the gardens of the outlying residential portions of the city and suburbs, and also in the scrub country at the base of the hills in Salsette.

It goes about in pairs, but is oftener heard than seen as it bursts forth every now and again into loud abrupt snatches of song. It is usually shy, but a pair observed in the shrubbery bordering the Pherozesha Mehta Gardens on Malabār Hill (July 1925) appeared to have become thoroughly sophisticated and were not at all perturbed by the proximity and bustle of the throngs of people out to 'eat the air' on a Sunday afternoon. From their behaviour it was evident that they had a nest in the shrubbery near the Post Office end of the garden. We have no recent information as to whether these birds still persist, but thanks to the presence of many suitable gardens and compounds in that neighbourhood, they are very probably still there.

The food of this bulbul consists of berries and fruit of many kinds, the more prominent species among them being *Lantana camara, Mimusops hexandra, Streblus asper* and various Fici. Spiders and insects are also eaten but to a lesser extent.

Breeding: The season lasts from early March to the end of August. Lt. H. E. Barnes (*J.B.N.H.S.*, iv, 249) found it breeding on Mount Sion (Salsette) in July and August. Aitken (*N. & E.*, i, 190) found a nest with c/2 on 14 September, and we have seen a nest with two newly-hatched chicks as late as 3 October. It is possibly double-brooded.

The nest is similar to that of the Red-vented Bulbul and is composed of rootlets etc. without any extra lining. It is flimsy and loosely put together. The site selected is in some low bush such as Lantana or Karonda (*Carissa*) seldom more than 4 ft. from the ground. The highest noted by Humayun Abdulali was in a date palm at about 15 ft., but it was never completed. One of our nests (containing young) was placed in (or on) the leaf of a young date palm about 12 in. off the ground. The leaf overhung a used cattle path, so that it must have been constantly brushed aside and violently shaken by the animals passing to and fro!

Almost invariably two eggs are laid, but Humayun Abdulali has once found only a single. The owners do not create the usual bulbul row when the nest is being pried into or handled. They merely sit at a distance and utter a low '*krr-kurr*' etc. of displeasure and concern at intervals which may be abruptly switched on into the merry rattling song.

(*To be continued*).

SHOOTING NOTES FOR THE CENTRAL PROVINCES.

BY

J. E. HALL.

(*With a plate*).

The following notes are submitted in the hope that they may be of assistance to impecunious sportsmen, like myself, who are unable to budget in thousands for their annual shooting holiday. That shikar and a lively interest in Natural History is not necessarily a rich man's pastime can be amply proved by the results I have obtained. It was the chance remark of a young friend in the Indian Army, who deplored the fact of his inability to go on a month's shooting trip due to the expense involved that induced me to write these notes.

The first recommendation I have to make to anyone wishing to shoot in the Central Provinces is to buy, beg, borrow or steal a copy of Dunbar-Brander's classic work, *Wild Animals in the Central Provinces*. With the help of the wonderful notes on the Fauna of the province, their habits, hints on shikar etc. one cannot fail to succeed in obtaining good trophies, and a complete education in the ways of the Wild. Make this book your constant companion at home and in the jungle, study your failures and successes in relation to Brander's observations, and you will in one month learn what our predecessors took years to discover by experience. Before going to your shooting block, please remember that there are several methods of transport. Except for short distances up to 200 miles or so a car is an expensive luxury. It is all right to get about in, but no shooting is permitted in the Government Reserved Forests from cars, and very rightly too. Besides one can see far more game in one's block by getting about on one's flat feet than in a car.

It is not essential to travel first class by rail, especially in a case where a journey of 500 miles is involved; with a certain amount of discomfort a friend of mine travelled 700 miles recently by intermediate class, and at a fraction of the cost of first class travel. I think it worked out at one-quarter of the cost, and was the only means by which he could balance his shooting budget. During the trip he improved his knowledge of the language, and the nature of the country to a remarkable extent, so much so that meeting a landholder of the United Provinces in the compartment he got an invitation to shoot there when he had some further leave. Most shooting parties move out from the District station of their block by bus or taxi; to date I had always done so and paid heavily for the doubtful privilege. This year, however, due to Election 'fever' not a single conveyance was available, so that I was compelled to fall back on either bullock-cart or pony tonga. I chose the latter and got a very pleasant surprise. Two ponies were harnessed to each tonga, of which I had

My orderly *Sajnoo Shikari.*

Tiger male 9 ft. 8 in. Mandla 1936.

Spotted Deer 35 in. Mandla 1936.

two to fit myself, servants and kit; and they got me to my block, a distance of 42 miles in ten hours including halts for resting the ponies and food. I have never enjoyed a trip as much before. It was a unique experience and at the same time a very satisfactory mode of transport inasmuch as my total expenses were a paltry Rs. 16 as against Rs. 42 usually paid to the *bus-wallah.* So much for cutting down expenses for the route. There are several other ways of economising, that will suggest themselves to the reader; I for one never beat for tiger, partly on account of the expense, and also due to the fact that in a beat for a guest of mine, where I accompanied the beaters, a wounded tiger turned back and just missed bagging me. From that day I have decided that it is not fair to the beaters to ask them to drive tiger with sticks and stones, when the sportsman with a rifle is safe up a tree. When writing to the Forest Officer of the District you have decided upon visiting, for a block, ask for two or three blocks at least, this enables him to allot you one in case any of the others are already reserved. It is best to write a couple of months ahead for the block. The block fee is Rs. 25 a month plus Rs. 10 for the new Game license, which the District Forest Officer can obtain for you from the Deputy Commissioner of the District. After obtaining your block, write thanking the District Forest Officer and ask him to let you know the best site to camp, and the nearest route from the Railway station or District Headquarters, also ask for the address of the Range Officer responsible for your particular block. So far I have found the Forest Officials in the Central Provinces very helpful and courteous in their dealings with me. On obtaining this information, arrange your plans, write to the Range Officer, informing him that you will be reaching the block by a certain date and request his assistance in the matter of *bodas* (buffaloes for tying up) and a reliable shikari. This officer is usually an Indian and, whilst being above accepting any gratuity from you, he can appreciate common courtesy. His help is invaluable and is freely given, though it is no part of his duties to cater for sportsmen. Having established contact, proceed to your block, take your rifles, kit, tentage and stores with you. Dealing with these I have the following advice to give:—

Rifles. A heavy double-barrel H. V. rifle is a necessity if any serious tiger shooting is going to be done (mine is a 450/400 D. B., H. V.). Especially in the case of following up a wounded animal the value of a quick second shot is most felt. A double-barrel permits of a very quick snap-shot being taken and in such circumstances is much more accurate than a bolt action single barrel type. Take soft nose split bullets for tiger, panther, deer and similar game, and a few solids for bison if you are lucky enough to be allowed one on the permit, and what is more, to find one. I have found twenty rounds quite sufficient for a month's shoot, in fact, I have only fired twelve rounds out of this rifle in two shoots, and only in one case was a second shot required on an animal.

Next, a medium weight rifle is useful, mine is a ·300 Springfield bolt action. This is light enough to be carried by the sportsman in his wandering round the jungles; is deadly accurate in taking the very often barely seen neck shots offered by sambhur and cheetul and in every way will prove its utility in bringing down black-buck, barking deer, pig etc. Whether to take a 12-bore shot gun or a ·22-bore rook rifle is a moot point. I favour the latter, as one can pot doves, *jungli moorghi*, etc. for the pot with the minimum of noise. A most essential proceeding if you are after tiger. Several shikaries I know use the 12-bore with buckshot or ball on tiger and panther. Unless the gun is a paradox pattern one, I most strongly recommend that it is not used in this way. With luck an animal is shot dead, but in most cases, especially as regards tiger, a follow up is the result, with danger to the sportsman or the unfortunate villagers who may encounter the wounded beast. During my last three shoots I have left my gun at home, as I found it quite superfluous on shikar, and one can with a little practice obtain excellent results with a rifle.

If you are in a district where the use of a torch is permitted at night for shooting; take it every time; with a good clamp arrangement to attach it to the rifle one can obtain deadly shots on any sort of night, dark or moonlight. Without the torch one has to chance a shot at somewhere on the tiger's body during a sit up. With the torch one can place a shot in the neck which will drop the tiger or panther where he stands.

A good pair of binoculars is most useful, as also a set of country-made skinning knives. Very often skinners are not obtainable and this means having to skin an animal with often enough very crude assistance from the junglies.

For tentage I recommend an ordinary 40-lb. 'officers' pattern double fly for oneself, with a grass hut, which the villagers will run up in a couple of hours for the servants. A canvas tarpaulin is useful for keeping off the rain from the servants, or for taking with one when after bison; as very often in this latter case one has to camp out in the jungles miles from camp.

A portable machan, laced with khaki-dyed *newar* tape, is excellent for sitting up, not only is it more comfortable than a village *khattia*, but it is not likely to creak at a critical moment.

As regards stores, one has one's own fancies in tinned provisions, it is advisable to buy these at your home town and bring them with yourself. All bazar provisions, such as flour, ghee, salt, sugar, etc., can easily be purchased from the District Headquarters nearest to your block. This does not apply to small wayside stations and one has to make arrangements to bring everything. At these latter places the only conveyance usually available is bullock cart, and don't expect these to move in mountainous country more than 16 miles a day. Don't forget to take about 8 lbs. burnt alum and some arsenical paste for treating skins with. It is very difficult to get alum in the interior, also a couple of hundred 3-inch nails for pegging down skins with. These are far more useful than bamboo pegs and do not tear a skin half as much.

Having discussed most of the shikari's requirements, I leave out petty odds and ends such as clothes, water bottles, lamps etc., servants are the next problem. I find that a good cook and an orderly are quite sufficient. The former is an absolute necessity, the latter if he has been to the jungles before a most valuable perquisite. He can superintend the tying up of '*bodas*', dry curing of skins, cleaning equipment and the hundred and one odd jobs that crop up in camp.

A stock of essential medicines such as quinine, iodine, salts, aspirin, permanganate, etc., is very helpful, in fact during the winter months when the jungles are still very damp—quinine, or one of its many compounds is essential to keep off Malaria. Dose yourself and your servants regularly as fever can ruin the best arranged shoot. When you are leaving your block make over your medicines to the Range Officer. He will appreciate them for himself and the poor villagers who have helped you in your holiday. In the jungles medicine is a Godsend, whereas back in civilisation it is always available.

Having settled where you will go, how you are to get there, and worked out your programme, expenses etc., decide what animals you mostly wish to shoot. This depends entirely on yourself and the type of game available in the district. Roughly speaking, the distribution of game is as follows:—

Tiger, panther, bear, spotted deer, sambhur, barking deer, in most or almost all districts of the Central Provinces.

Bison in Mandla, Balaghat, Raipur, Chanda and other districts south of the Nerbudda.

Swamp deer (*bara-singha*) in Mandla only. Shooting in other districts is prohibited as these fine animals are getting very scarce.

Buffaloes are preserved throughout the province, as they are very scarce and only available in the Raipur District.

To illustrate actual experiences let me describe a recent shoot. Getting down at Mandla Fort this February, I called on the District Forest Officer whom I had met out shooting the previous year, to make my 'Salams' and get the latest news of my block. In passing I may mention that this particular gentleman is one of the finest officers that I have met in my wanderings throughout India, scrupulously fair in his dealings with shikaries, and always ready to help a fellow sportsman. You will find his type the rule rather than the exception in the Central Provinces and Government forests elsewhere throughout India. After a hearty breakfast, which I enjoyed, being ravenously hungry, I set out in search of a bus or taxi to get me to my block, with the result already shown. However the tonga journey was a novel—and to me intriguing experience, being as I am very keen on horses of any description. I reached my block the next day as I broke journey about half way to get a decent sleep in the last dak-bungalow on the road. Arriving at the Range Officer's headquarters I was given a cordial welcome as he was an old acquaintance from the previous year. Armed with all the newest '*khabbar*' and with all arrangements for shikaries and '*bodas*' complete I pushed on to the village recommended to me by the District Forest Officer on foot, a distance of 16 miles, the luggage coming on by bullock cart. Camp was pitched about 8 p.m. and after a healthy dinner of village *moorghi* and '*chappaties*' washed down with the last of the beer I had, prospects of shikar were discussed over a roaring log fire. It was ascertained that there were two, quite probably three tigers in the block, and that one of them lamed in a beat some twelve years back and consequently called '*lungra*' by the villagers, was not only remarkable for his size and weight, but also very bold in his dealings with human beings, having mauled a couple of beaters and cowherds during his career, and distinguished himself by nearly pulling a sportsman out of his machan the previous year. Withal, he was said to be remarkably cunning. This was a pleasing prospect, further set off by Sajnoo the shikari waking me up at 4 a.m. to hear a big *bara-singh* stag roaring. I have been after a good stag for two years but without success and life was indeed rosy.

It was decided not to fire a shot until 'Lungra' was brought to bag, so that concentration was set upon the tie-ups. The first three days brought disappointment to everybody; myself because no kills were made, the shikaries because I would not fire at an enormous wild boar that we met early one morning on our way to inspect the '*bodas*'. The fourth day was memorable; coming down from a high hill where we had sat to look out for *bara-singh* in an adjoining maidan we disturbed some animal near a small spring on the face of the hillside. The wavy motion of the high grass indicated a tiger moving off, but it was impossible to get a glimpse of him due to the dense grass which was at least 8 ft. high. A careful examination of the spot from where he had moved disclosed this as a favourite lie up of the famous 'Lungra'. There were several forms, both old and new where he had rested, and hair and pugmarks in plenty. These latter bore out the statements of the junglies, that the tiger was very massive. They were huge and I could fit eleven fingers in the indentation of the pug. Furthermore the right foot turned inwards considerably indicating some defect or deformity in the conformation of the foot. A start was immediately made for camp by a round-about way to avoid disturbing the tiger more, and at Sajnoo's suggestion we started talking in ordinary tones, cut a few bamboos etc., as if we were just woodcutters in the jungles by chance, as it was known that the tiger was very suspicious and any hint of unusual activity in the jungles sent him in hot haste to safer quarters. A sudden barking of a barking deer quite close at hand on the opposite face of the valley seemed to indicate that the tiger was watching us, and a look through the glasses showed that the deer was stationary, barking furiously at something in the bamboo covert, the chattering of a pair of magpies round and about a particular spot also indicated the presence of the tiger. That night a buffalo calf tied on the direct path leading down from the hillside at a place called Karipahar was taken by *lungra*, he had however bitten clean through the fore leg by which the bait was tied near a suitable machan tree and taken it right away. The long and short of it all was that we never found a trace of the kill. This was a gloomy outlook, and indicated an extraordinarily cunning beast. Strategy was essential to get a chance at him, so the next night three bodas, all carefully selected for size were tied up in the same spot. Instead of the usual picketing peg, each beast was tied to a fairly long and heavy log of wood, which it could drag to some distance, and the rope was passed around the base of the horns. The scheme succeeded. Next morning disclosed two of the bodas hale and hearty, but some distance from their original picketing point, they had bolted on seeing the tiger and got held up in the jungle by the logs to which they were tethered. A pool of blood in the path of the third beast's drag showed that a kill had taken place and, what was more, the tiger had dragged *boda* and log leaving a clear trail to follow. The next step was to get some of the village buffaloes and after taking lunch and getting all the requisites for sitting up, to follow up the drag in such a way that the tiger thinking we were village cowherds had no suspicions that we were after him. Beating was impossible due to the unbroken nature of the forest and to the genuine fear the villagers had of this tiger. It took us forty minutes to locate the kill in a dense bamboo thicket on a steep face of the hillside. Had I not seen for myself how the 2-year buffalo calf complete with tethering log, had been dragged up that hill through dense coverts and over fallen trees 3 and 4 ft. high off the ground; I could never have believed a tiger capable of such remarkable strength. It was a revelation of a tiger's strength, a path like the track of a roller marked the progress of the tiger and his kill. It was just as well that we had taken the precaution of locating the kill with buffaloes as the tiger was sitting near the kill in dense bamboo cover when we found it and was seen moving off across a small nullah. He was going calmly and without fear, looking back at the buffaloes who had grouped together on getting sight of him. Unfortunately I was examining the kill at the time and so missed a chance of getting him as he crossed the nullah. Hastily and with the minimum of noise a machan low down in a bamboo clump was made, well screened with small bushes. I settled myself down at 4 p.m. and my men moved off with the buffaloes talking loudly. At 5 the tiger crossed the nullah, I could not see him, but distinctly heard the thud as he jumped down the bank, after that two magpies kept me informed of his every movement, he crossed the nullah on my right rear, and carefully circled across my front, not showing an inch of his hide, and with long pauses behind bushes or bamboo clumps. Having made a complete circle I next heard him sniffing where I had had my tea right behind me, at this time I thought that he would locate me as he was only a few yards behind me and I was very low, not more than 6 ft. off the ground. After this there was silence for a few minutes and he started circling around the kill again, this time he made enough noise in the bamboos but was very careful of showing himself. I only got a very occasional glimpse of his back or tail. Having satisfied himself that the coast was clear he started moving away to cross the nullah on my left rear and gave me a splendid shot from about 5 yds. I saw him clearly, his eyes were searching the trees in the vicinity of the kill and the slight movement I made in raising the rifle caught his attention. He stopped dead. Whether it was the shock of discovering me or whether it was his intention to pull me out of the machan, I cannot tell, but he threw his weight back on his hind legs in the attitude of springing. This was his last action. A shot in the neck laid him out, with hardly a movement except for a spasmodic twitching of the tail, and a couple of deep breaths. By this time, 5-30 p.m., I was feeling the strain. He had kept me on the alert for 1½ hours, and the shock of discovering that a tiger was cunning enough to look up for a machan, the first instance of the kind in my experience, set my nerves tingling. Honestly I felt funked, realising that I had been horribly careless about the whole show. After giving him time to die comfortably I got down from the machan and had a look at him with the torch. He was a magnificent tiger, by far the best I have ever shot or seen shot. He taped as he lay 9 ft. 8 in.; with a short tail he was unusually massive, measuring 16 in. round the wrist, with an immense head. His shoulders were square at the top, and his quarters developed to such an extent that he looked like an exceptionally well fed pony, with a depression along his back about two fingers deep along the line of his backbone. He was very pale in colour with wide spaces between the black markings, indicating an old beast. I was sorry that I had no machine to weigh him. Sajnoo and the other forest villagers assured me that they had a personal knowledge of this animal for the past fifteen years, partly due to the deformity of his right fore foot. This on skinning was found to be due to a bullet, traces of which were found encysted in the skin near the wrist joint, having broken one of the bones of the fore arm, which had healed, and also shattered one of the numerous tendons of the leg, thereby causing the foot to turn inwards. The wound was quite healed except for a peculiar raw patch on the skin covering the cyst where the bullet was embedded. This I think was due to the tiger having fallen into the habit of licking the spot, either to stop irritation, or merely from force of habit, as the wound appeared to be of very old standing. That night was further remarkable due to my getting an awful fright; after seeing the dead tiger, I got out my blanket and lay down near the machan on the ground for a comfortable sleep, as the machan was too cramped and my men had not turned up with a lantern to take me back to camp. About 1 a.m. there was a terrible scuffling and roaring going on at the edge of the forest. I woke up and was up the machan in about three seconds, whilst the sounds of terrific fighting went on close by. Roaring, snarls, terrific crashing in the jungle kept me fearfully excited in my machan for about half an hour after which the sounds of strife passed on. It was definitely tigers, but what on earth had happened. Morning and my men brought enlightenment; it appeared that a strange tiger following up the *gowlies'* cattle had taken one of my tie-ups, but had been driven off the kill by another tiger from the range. As the fight took place almost across the path by which my men were to come for me they decided to call it a day, and leave me on my machan, whilst they went back to camp as hard as they could move.

After that luck deserted me in every sense of the term, both tigers in their fight crossed my block boundary, and were promptly bagged by a shikar party who had the next block. There was one possible tiger left but as he had his beat across the hills in a neighbouring Native State, and only crossed into my jurisdiction at rare intervals, the chances of getting him were remote. I put out three tie-ups, on all the roads by which he was known to come into the block, but for several days nothing turned up.

Meanwhile every effort was made to get a good *bara-singha* stag, but though several groups of hinds were seen and one immature stag, the big stag that we had heard calling on my first night eluded me. At last he was disturbed out of a remote maidan, in size about half of an average polo-field, by some wandering cowherds. A frantic search of two days showed that he had crossed the road into another block, which was for practical purposes a sanctuary, as one stag had already been shot there at Christmas. Moreover the block was not mine, and disappointment for the second year faced me. Everything went wrong, following up recent traces of a solitary bison, we put up a fine sambhur stag, pucca 40 in., by the time I changed my solids for soft nose bullets in the rifle he got away; and we never saw him again. Terribly disheartening, and I regretted not having taken the shot with the solids I was loaded with. After all this down came the rain and as I was camping light, miles away from camp, everything including myself got a severe drenching. Malaria which attacks me at the most awkward times set in and I was laid up for five days. During this period there was a kill where we were tying up for the State Tiger, but this turned out to be only a panther. He gave the woman who was bringing in milk to my camp a fright by growling at her and disputed the pathway on which he was eating the kill, in the morning; not having bothered to drag it a few yards into a convenient nullah. Impudence of this nature deserved punishment, more especially as my wife was frightfully keen on a skin to match one I had got her the previous year, for making up an evening coat. Being too shaky to walk I rode the Ranger's pony to the scene of the kill and sat up on a shaky machan, which wobbled alarmingly every time I had a go of ague. The panther obliged however by not keeping me waiting more than forty minutes. He was a short way up the hillside and I could distinctly hear him scratching himself occasionally; as he was coming up to the kill, a barking deer set up a continuous noise, and next I heard a tiger 'pooking' from the other side of the hill. At the time I thought it was a sambhur, and taking no further notice I waited till the panther was below my tree and laid him out with a shot behind the shoulder, a neck shot being too chancy in my shaky state. As he rolled over gasping and struggling, a heavy beast crashed up the hillside for a short distance, after which all was silent. My men came up and asked what I had fired at, I told them panther and showed the animal to them. Sajnoo then went a short way up the hill, and when he came back his face was eloquent enough. The pugs showed that a tiger had been moving on to the kill, had 'pooked' seeing the panther and fled at the sound of my shot at the latter. The panther on being skinned disclosed that the whole of the chest and neck were one mass of fresh clawmarks and scars, with a deep hole on the back of the neck. In fact he bled quite freely from this latter hole when we were carrying him back to camp. By this time I was too far gone with fever to even consider sitting up for the chance of the tiger's return, which was a wise decision as he never came back. The problem, of course, which I leave my readers to solve for themselves, is, Who made the kill? and did the panther which was a big beast 7 ft. 8 in. in length drive off the tiger after a fight, or did the tiger drive the panther off, and on his leaving the kill in the morning the panther took his chance for a few mouthfuls. Also in the evening did the panther attempt the same trick to get a meal before the tiger put in an appearance. Anyway I never saw the tiger again.

After this luck changed and one morning whilst I was trying for a barking deer, which I got, and incidentally one that is almost a record, the right horn measuring 7 in. from the base to tip, excluding pedicle, we came across the grandpapa of all the bears in the block. My shooting was atrocious and it took six shots to finish him off, after a chase lasting the best part of three miles up hill. During the course of the chase he turned and came at us from above twice, once right up to within 4 ft. of me; but the fates were kind and a shot turned him in each case so no damage was done. He was a monster almost as round as a beer barrel.

So far I had been extraordinarily lucky as I had bagged the best tiger and bear that it had ever been my fate to see, but leave was drawing to a close and I had to make tracks homeward. As a last effort however I went to a small bit of jungle just alongside the main road, where I had heard that there were several spotted deer, and I wanted a good stag to take his neck and mask skin to mount a good 34 in. head I had at home. The entire morning and evening failed to show up a good stag, and I wasn't going to offend the Forest Officer by bagging a small head. However next morning when the carts were moving off I had another go, and, as I was coming out of the forest on to the road, I caught sight of a stag and a couple of does feeding across a grassy nullah. Moving into place for a shot, a lovely stag showed himself behind a bush. One quick look through the glasses showed that he had a fine head in hard horn, being February this was rather early for this; the shot was a long one every bit of 250 yds. and no rest available. He was only showing his neck and head, but the little Springfield carried true and he went down with a broken neck—35 in. on the beam with a beautiful symmetrical head, though rather light in girth.

Besides the above game mentioned, some pig were shot for the shikaries, one being a fine boar with $8\frac{3}{4}$ in. tushes. Several sambhur were seen but except for the big stag that got away, nothing worth adding to a collection consequently none were shot. The same applies to the only *bara-singha* stag put up. Two bison were disturbed, but as their tracks showed them to be cows, they were not followed up.

The above represents what a shikari of average means, determined to work hard for his trophies can get in a shoot lasting 17 days in the jungle, excluding time taken in getting to and from there, in this case 6 days. Besides the above the author has obtained a 42 in. sambhur, a 24 in. black-buck, besides other game in the Central Provinces which shows that there are good enough heads obtainable.

I think the following measurements may be taken to represent shootable game:—

Sambhur, shoot nothing under 38 in.

Bara-singha, nothing under 33 in. and full 12 points, though sometimes a 35 in. or 36 in. head with only 8 and 10 points can be had, in this case I think a shot is legitimate.

Spotted Deer, 32 in. and over should be your aim.

It is impossible to set a standard on barking deer or 4-horned antelope, though a black-buck under 20 in. in the Central Provinces is the rule rather than the exception in hilly country.

Bison, of course, is limited to a solitary bull, and in such cases the horn is usually worn down considerably at the tips, and would not go to much over 26 in. in length. Girth and spread would count as deciding factors in a case like this.

Don't forget that you are limited to one of each species in your permit, so that a hasty shot at an immature animal may well cost you a glorious trophy, which in nine cases out of ten you will come across when your limit is shot out. Besides which it is not fair to shoot a poor *bara-singha* or bison, considering the comparative rarity of these two species. Nor is it cricket to shoot a herd bull of the latter species, you may get away with it; but rest assured that if the District Forest Officer finds out no excuse will be accepted, and besides a heavy fine, you will find that your future applications for blocks are turned down.

There are far too many tigresses with cubs or bears with cubs shot, by keen though ignorant sportsmen. The same applies to animals that are much too small to furnish a trophy worth the expense of mounting. Let such animals go, even if they kill your baits; your forbearance will be rewarded sometime. Shoot panthers of any size, as well as wild dogs as they are a pest and destroy a lot of game.

Regarding the previous remarks two instances stand out rather vividly in my memory. The first case was where during a shoot the writer spared a small tigress with two cubs that came on to the kill, and kept him intensely interested whilst they fed. Later on another sportsman (?) shot the same tigress over a kill and one of the cubs, which was hardly 7 ft. in length. The other after starving for some days was beaten to death by some villagers with sticks. This was in zemindari forest where such things can happen. This man's greed over one small tigress wiped out the entire family, which in a few years would have produced at least some trophies worth keeping.

Another case was where a shikari, and an Englishman at that, who went on a tour of three months' shooting in several blocks. He bagged ten tigers, of all sizes, of which he had two skins mounted and advertised the rest for sale. What good did he do, he neither kept the trophies himself and by his action deprived some other sportsman of getting a tiger.

Especially as regards tiger and bear, there appears to be a mistaken impression that quantity not quality is the hall mark of the shikari. It would be a very good thing if the Government set a limit on the tiger permissible to be shot in any one block during one year, with a further restriction in the number allowed per permit. As it is, tigers are being shot out of existence and have disappeared in several areas, where formerly they were quite common. Surely, the tiger requires as much protection as deer, and can be classed as game to the same extent. It is the tiger that brings the sportsman and the sportsman that helps to keep down poaching. Take away the tigers, and very few men would spend their time and money in the jungles. Poaching would increase enormously, and the flow of ready cash, so important to the poor forest villagers in lean times, would soon cease. This is a question that would bear careful investigation.

As some indication of the expense involved in a shikar trip to the Central Provinces, I may mention that the expenses of the shoot described, excluding rail fares, but counting all else, including conveyance to the block, cost of *bodas*, and fresh provisions totalled Rs. 220; a figure that is low enough to be within the means of most of us. If one intends to beat for tiger, then an additional Rs. 40 per beat has to be budgeted for. I had four *bodas* killed out of 6 tied up and the cost of these four was Rs. 32 with another Rs. 4 as *bakshis* to the owners of the two remaining, which they took back. Rewards to *shikaries* depend entirely on one's means, but I usually give Rs. 10 per tiger and bison; and Rs. 5 for bear, panther and *bara-singha*. I find one shikari at Re. 0-8-0 per day, one gun-bearer at Re. 0-6-0 per day, one *boda-wallah* to each tie-up and two spare men to assist around the camp and with machans etc., all at Re. 0-4-0 each a day ample for my requirements. I usually give Re. 1 to the *boda-wallah* whose tie-up has been killed, as also to any villager or cow-herd who brings in news of a natural kill. This ensures keenness. Sites for the tie-ups are all selected by myself and the shikari in consultation, and after careful examination of the block; and the tie-ups are not moved from their sites until it is certain that no tigers are in that part of the block, as a tiger has a very extensive beat, and may take several days to cover it in his rounds.

Boda-wallahs whose *bodas* have been killed are utilised as game scouts and their job is to move about in couples trying to locate areas where game is congregated, the pair bringing in reliable information getting a leg of any animal bagged especially for themselves, plus a little extra *bakshis* in the case of a good head or a bison. A considerable amount of foot-slogging and futile wandering around the jungles is avoided by the shikari in this way. Should tiger be the desired object, unnecessary firing near the kills should be avoided. In fact the sportsman should not pull trigger unless a fine stag or other animal is involved; any thing approaching a drive for game or *jungli moorghi*, with attendant noise and firing will drive all the tigers out of the block miles away. From being so consistently hunted, in the Central Provinces tiger have, I think, developed a high degree of self-protection complex in addition to their natural instincts.

The best months for general shooting are from November to March; not only is the weather delightful, but all game is in hard horn and tiger in their winter coats with well developed neck ruffs on the older animals. Hot weather shooting is easier as regards beating and locating tiger, but a hot weather skin cannot compare with a cold weather one, and besides all game excepting spotted deer have shed their horns.

Always take a camera with you and many pleasant moments can be re-lived again when tied down to the daily grind. If you are a photo fiend there may be some excellent chances to obtain interesting Natural History snaps. Special permission is necessary to operate a flashlight outfit. Take notes and measurements of all game obtained, and also jot down the result of your observations, successful attempts or failures etc., with what you consider contributing factors. In this way you learn a lot and can correct future mistakes made by your jungli assistants. Information from these is often valuable and interesting, but requires careful dissecting to separate the actual from the imaginary.

Lastly a knowledge of colloquial Hindustani is invaluable.

NOTES ON SOME INDIAN BIRDS.

BY

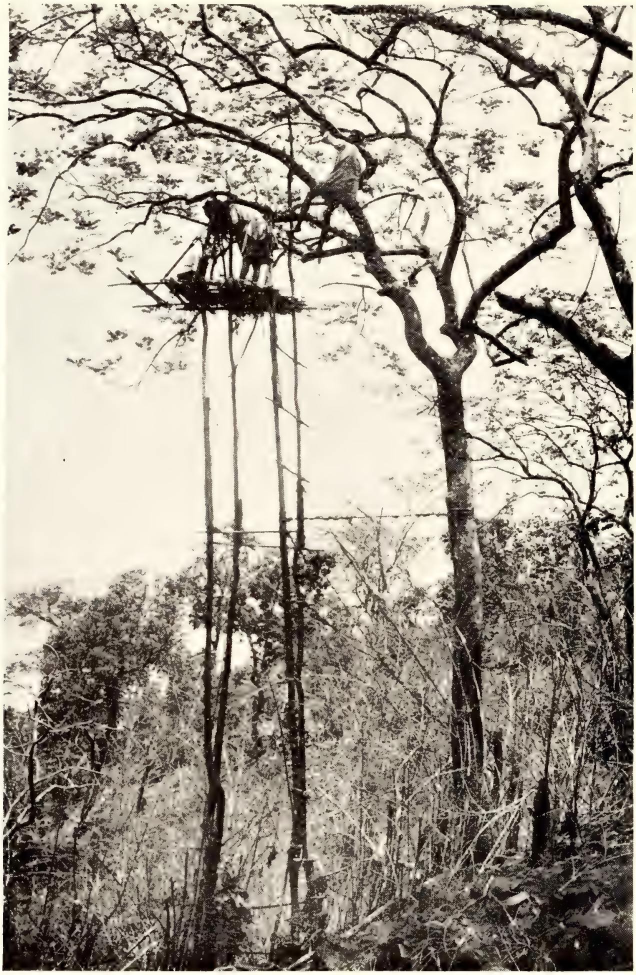
E. H. N. LOWTHER, M.B.O.U., F.Z.S.

(*With* 6 *plates*).

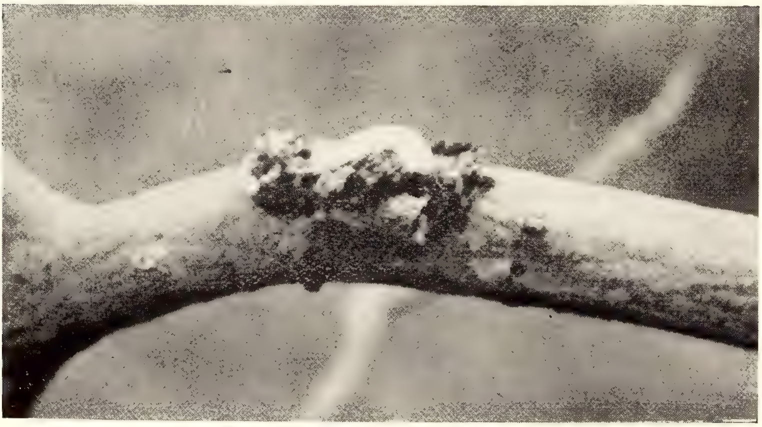
I.—THE INDIAN CRESTED SWIFT.

It is not unnatural that the student having learnt something of the Bird-life of a country should set his heart on making the acquaintance in the field of a particular species. What is strange, however, is that the bird he is so anxious to study almost invariably is not to be found in the district where he resides. Such precisely was the case with two bird-lovers of my acquaintance; the one had always wished to meet the Racket-tailed Drongo in its forest home, the other a Great Indian Hornbill. Both had spent years in India without seeing the objects of their curiosity, and both were certain to be unable to gratify their wishes so long as they continued to reside in those particular parts. It was just the same in my own case. Constant perusal of Hume's *Nests and Eggs* and the Bird volumes of the *Fauna* attracted me specially to the Crested Swift and the Masked Finfoot. The latter, of course, I shall never see in the wild state unless I visit certain favoured localities in Assam or Burma, but there was no reason why some day I should not have an opportunity of studying the Crested Swift at home. As ill-luck would have it the first twenty-two years of my service were spent in places where this species is not to be found, and, it was not till 1933, when posted to Dhanbad in the Manbhum District, that I was able to make the acquaintance of the Crested Swift. When I saw these charming and graceful birds in the neighbouring district of Hazaribagh, I knew that with any luck I should also find them in the hills round the Topchanchi reservoir, or in the neighbourhood of Gomoh —localities easily accessible from my home and both in my own district. Just possibly too I might happen on a nest. Accordingly, the next two or three occasions I was out after birds I was constantly scanning the skies in the hope of seeing a Crested Swift. Many a time a distant speck which I thought might be this bird turned out to be some other species; often in my anxiety to locate it I mistook the cry of a paroquet for that of the Crested Swift. Eventually, however, in the Sikda Pahar *nala*, where this debouches into rice fields, I spotted half a dozen Crested Swifts flying overhead hawking for insects and occasionally settling on some *simal*, *mhowa* or *dhoka* trees, once on a tree on which, lower down, a Franklin's Nightjar was resting lengthwise.

Returning to the spot on the 2nd July I watched those Crested Swifts for nearly three hours, following them carefully with the



1. Machan from which the first Crested Swift was photographed, 1936. The bird can be seen seated on the nest.



2. Crested Swift's nest.

Photos by E. H. N. Lowther. *Copyright.*

glasses in case any of them were still nesting, although fully aware that their normal breeding season was now well over. Repeated inspection of trees on which the birds perched revealed nothing. It was obvious they were only resting. I had almost given up all idea of finding a nest of this species when I saw one of the birds settle on a *dhoka* tree higher up the hill side than had been the case with the others, and consequently in thicker jungle. To this I toiled, expecting to draw the usual blank. To my amazement, however, there was the Crested Swift sitting on what close inspection proved to be a nest. To say I was delighted gives no idea of my feelings. To begin with, the species is very local and the nest one of the most difficult to find, so much so, that I had always imagined—why I know not—that it was never to be my good fortune to see a Crested Swift's nest *in situ*. In the same way as a boy, I had felt that the Red-necked Phalarope's nest and eggs were not to be found by the likes of me. (I may say I later found four nests containing eggs of this rarity when in the Hebrides during the summer of 1914.) Added to all this, it was very late for the Crested Swift to be still nesting, the usual breeding season being during April and May.

As I gazed at the bird seated on her tiny nest only twelve feet up from the ground, I feared I should burst with happiness. I felt I had reached the topmost rung of my hopes, and, that having photographed the bird at home, I could retire gracefully from camera-nesting operations in India. So bold was she that I was able to stand within seven feet of her. She made such a beautiful picture that I determined there and then that if ever I wrote a book about Indian birds her photograph should form the frontispiece to the work.

It was too late to erect a *machan* that evening, but this was done the following day by my *shikari*, who later reported that throughout the two hours he took in building the scaffolding, securing the platform near the top, and fixing on it the hiding tent thrown over a rough tripod, the Crested Swift never once left the nest, although for some considerable time he was standing within five feet of her. This augured well for my chances of obtaining photographs so that I went to bed greatly excited and looked forward to the morrow with more than usual anticipation. Instead of the cawings of rooks coming to me in my dreams that night—as they often do—I dreamed of the Crested Swift. All the details of my watchings and great discovery flashed through my subconscious mind again, and—such is the joy of photographing a new and rare species—I even imagined myself showing the Crested Swift slides to a large and appreciative audience!

July 4 broke fine and the Crested Swift was as good as photographed—or so I supposed. Twenty miles by car and a mile on foot took me to the nest on which I was somewhat surprised to see no bird sitting. Concluding that the owners must be away hawking for insects and that one of the pair would soon be back, I commenced to unpack the camera, only to find the Crested Swift's egg lying broken close to the spot where I was kneeling, the contents still quite fresh. What had obviously happened was that some inquisitive wight had climbed on to the *machan*, seized the branch on which the nest was built, pulled it towards himself, and after inspecting the contents, released it suddenly so that the egg was catapulted on to the ground some few feet away.

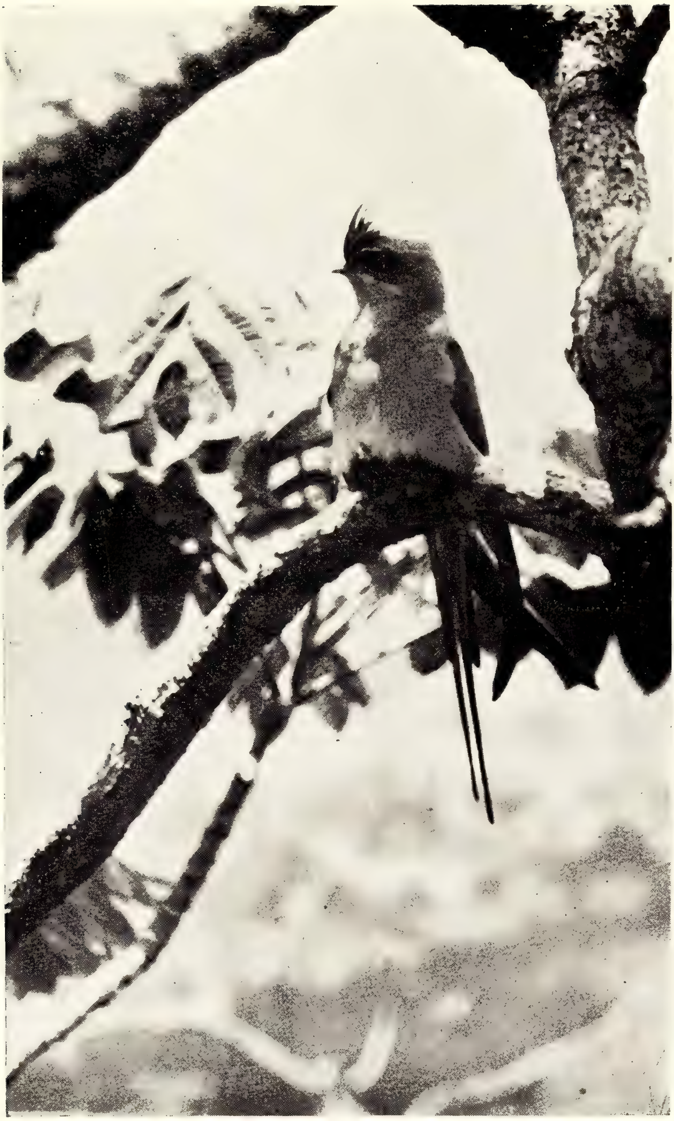
My feelings can be better imagined than described. I need only say here that in all my experiences with a camera this was my greatest disappointment. It seemed to be expecting too much to find a second nest of this species even though both my *shikari* and I now knew exactly what to look for. However, as I was still stationed at Dhanbad the following year, the last week of March found us both concentrating all our efforts on finding another nest. Birds we saw in three widely separate places—several of them—but the wonderful little edifice eluded our best efforts.

Imagining that it might be rather too early to find a nest in these parts I ceased hunting for some days, ordering my *shikari* to keep a constant lookout the while. Eventually he reported on April 4 that he had that morning found a nest containing an egg, but that it was built at a great height from the ground.

A personal visit early the following day confirmed Sakroo's statement—the nest was a good forty-five feet up. I did not like the look of things at all. It was not so much the height that worried me as the fact that below the nest the ground was solid rock, making the erection of a *machan* an impossible matter; while to put up the *hide* in the tree itself was equally out of the question. The only thing to do was to look for yet another nest!

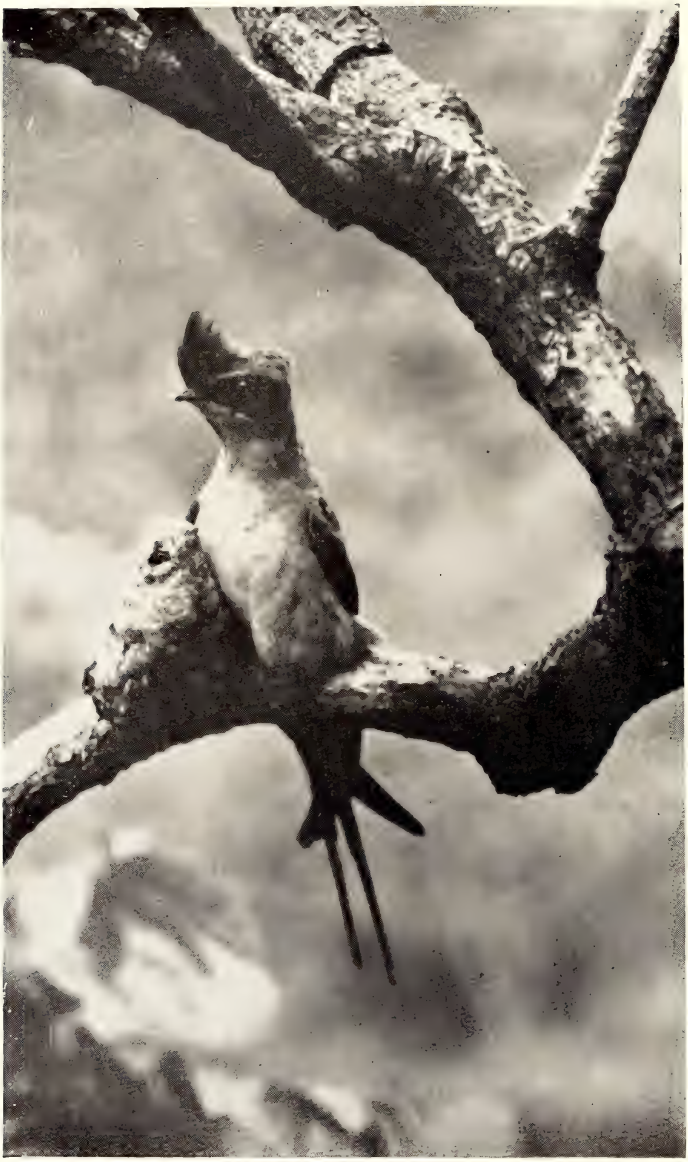
Inspite of previous misgivings, I now entertained great hopes of locating one, as in this *nala* there were three pairs of Crested Swifts. Nevertheless, it seemed as though I was again to be baulked of my prize. True, the *shikari* succeeded in finding another nest in course of construction, but this for some reason the birds never completed. We both looked elsewhere, but without success, and we eventually returned on April 13 to the range of gently-sloping hills, where Sakroo had found the impossible nest on the 4th. We examined the country in a more westerly direction, where numbers of *simal* trees spread their horizontal but leafless branches over thin scrub-jungle and rocky ground—the breeding haunt of at least two pairs of Franklin's Nightjars. Here, after more than an hour's 'glassing' under a terribly hot sun, I traced a Crested Swift to its home, one that was clearly photographable from a *machan*. This I had built the following day, and over it a minion remained to keep watch till darkness set in, as I was anxious to avoid the tragedy of the previous year.

Before proceeding further, perhaps it would be as well if I described the Crested Swift and said something of its nesting arrangements. The bird is about nine and a half inches in length, the general colouring of the upper parts a bluish-grey, the crest much darker, and the wings and tail dark brown, the crest, wing-coverts and tail being in addition glossed with green. The under parts are a light ashy-grey, becoming white on the abdomen and under the tail. The sexes are similarly coloured except that the warm chestnut patch on the sides of the face in the male



Crested Swift.

Photo by E. H. N. Lowther, 1936. *Copyright.*



Crested Swift on nest.

Photo by E. H. N. Lowther. *Copyright.*

is replaced by grey in the female. There is also a tinge of chestnut on the edge of the male's chin which is absent in the female. Unquestionably the bird's most striking feature is the crest. This seems always to be carried erect while the Crested Swift is either incubating or brooding but is depressed in flight and also when the parents feed their offspring. It is as often erect as depressed when the bird is resting on some tree but is erected when it calls. When erect it gives the owner a peculiarly jaunty air. In flight the long tail feathers are most prominent. These are either pencil-pointed, giving the Crested Swift a very paroquet-like appearance, or are strongly forked. When at rest, the long tail feathers may either remain together or be slightly apart, as shown in some of the accompanying plates. The bill, of course, is short with a wide gape, and the wings long and scythe-shaped, as is typical in Swifts.

So far as my experience goes—and I have now studied the bird in several places in the Manbhum, Hazaribagh, Ranchi and Palamau Districts—the Crested Swift is to be met with only in fairly well-wooded or scrub-jungle country, where low or moderate-sized hills occur. My remarks, of course, apply to the months of April and May. With the breaking of the monsoon, it would be more correct to describe the jungle as heavy. In those haunts which it favours, the species may be seen in small parties of three, four or even more pairs, wheeling gracefully over the tree-tops in search of gnats and the other minute insects on which it feeds, sometimes even diving through the larger branches in quest of these, and, if there is a tank handy, constantly dipping down to its surface. The flight is much slower than is the case with other Swifts. From time to time, the bird perches on some bough near the top of a favourite tree and devotes much time to its toilet, frequently giving vent to a loud call, *kip-kee-kep*, the middle syllable much emphasised. This note is also uttered freely on the wing, but then consists usually of only two syllables.

Although resident in those districts where it occurs, these Swifts wander considerably in quest of food. A *nala* which the party haunts to-day will quite likely be deserted a fortnight later in favour of some other suitable spot four or five miles distant. This in turn will give way, when the food supply runs short, to yet another timbered hillside; and so on. Always, however, the different members comprising the party seem to return for nesting purposes to what, for brevity's sake, I may call the permanent home.

The nest is a truly wonderful piece of architecture but since no pen-picture I draw can do justice to it I offer no apology for quoting Whistler's description. He says:—

'The nest is a most remarkable structure. It is a very shallow half-saucer composed of thin flakes of bark and a few small feathers gummed together with inspissated saliva on the side of a horizontal branch. The nest is nowhere more than an eighth of an inch in thickness and is at most half an inch deep in the deepest part. The largest outside measurement is 2 in., which is to say, that the nest can be covered by a crown-piece, The branch chosen is usually a dead one often at the top of a high tree, but many nests are built much lower down on small trees growing in open scrub-jungle. Viewed from below the nest has all the appearance of a knot and would seldom be detected were it not for the fact that the female returns at frequent intervals to it. The single egg completely fills the nest. The parent bird sits across the nest and the branch to which it is attached so that the latter takes her weight.

The egg is a very elongated oval, obtuse at both ends and with little or no gloss. It is white with a slight greyish-blue tinge. It measures about 0·94 × 0·62 in.'[1]

While Whistler's description of the nest and egg is very accurate, some of the statements he makes cannot pass unchallenged; others need amplifying; and, although the observations that follow are based on an examination of only six nests, I make these for what they are worth in the hope that what I have to say will encourage others to investigate the habits of this interesting species and so help to solve the many problems with regard to its nidification which still require solution.

First of all—how are the strips or flakes of bark with which the nest is constructed obtained? I noted the following after examining my first nest:—'A striking feature of the material used is the precision with which each piece of bark is cut. These are regular and perfect squares and all of approximately equal size.' I have since come to the conclusion that the obtaining of this material is not the difficult matter that it appears to be at first sight. When a Crested Swift begins to nest, the bark of various trees such as the *simal* and *dhoka* is peeling off in small pieces, and as the ends of these flakes invariably curl upwards, it would appear that the Crested Swift experiences no difficulty in tearing them off. The flakes of bark correspond to the tree on which the nest is built, and it is not improbable that the material is obtained from the identical tree which accommodates the nest.

The nest-branch must be a thin one as otherwise the Crested Swift would probably experience difficulty in 'taking off' owing to the great length of its wings. The following are the diameter measurements of three branches at the nest-site:—

(1) 0·72 in. (the 1933 nest).
(2) 1·03 in. (the 1934 nest, on which I first photographed the Crested Swift).
(3) 1⅛ in. (the first nest found in 1936 and which I sent to the Society on the egg being destroyed).

Not one of these branches was dead; in fact all the six nests which have come under my observation were built on live boughs. Two other nests my *shikari* found, but which I did not have an opportunity of inspecting, were also constructed on living branches. My experiences have, therefore, either been unusual or Whistler—and others—are not correct in stating that a dead bough is usually selected.

As I have given the measurements of branches at the nest-site

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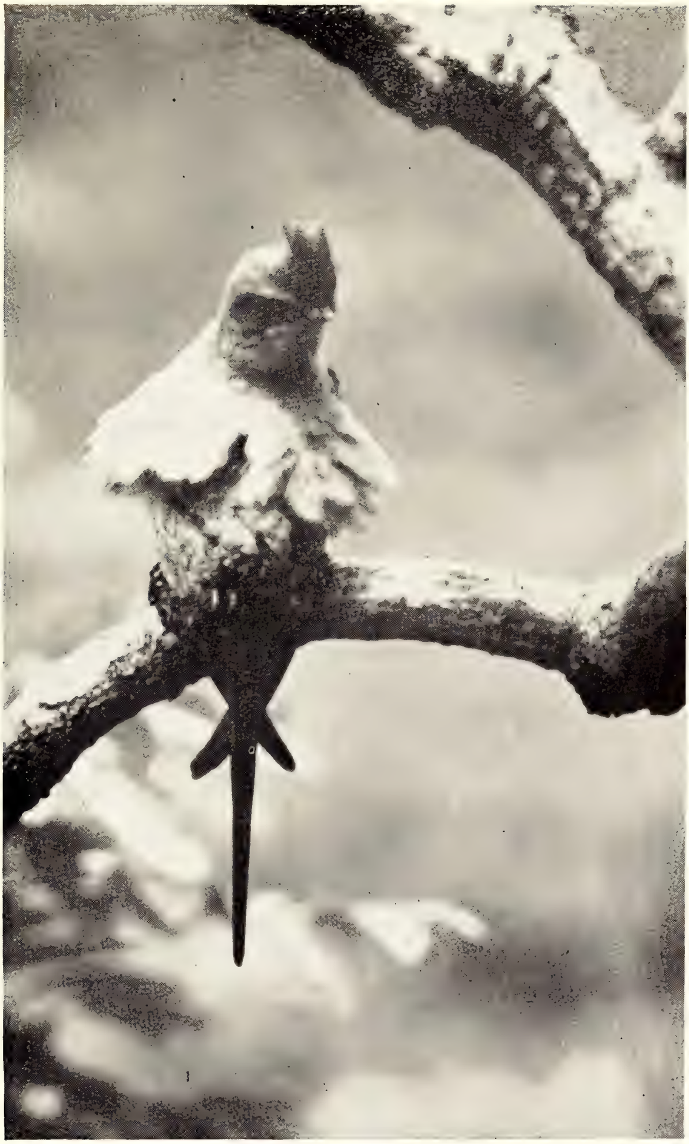
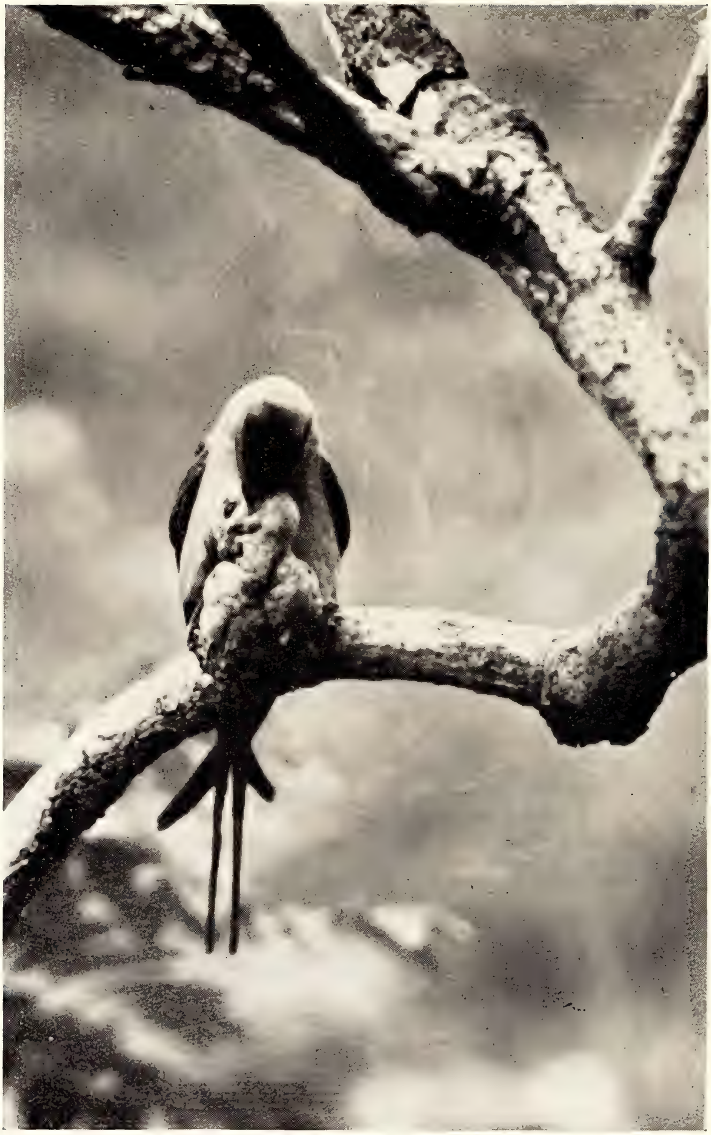
[1] *Popular Handbook of Indian Birds*, 2nd edition, p. 277.



It appeared that he was wearing a cape.

Photo by E. H. N. Lowther. *Copyright.*



Male Crested Swift feeding young.

Photo by E. H. N. Lowther, 1936. *Copyright.*

it will not be out of place to quote measurements of the nests themselves. These, where obtainable, were:—

(1) 1·75 in. long by $\frac{15}{16}$ in. wide.
(2) $1\frac{10}{16}$ in. long by $\frac{3}{4}$ in. wide.

I was not in a position to measure the thickness of either of these nests, but Mr. Prater informs me that the nest I forwarded to the Society is 10 mm. thick.

The height of the nest from the ground varies considerably. The lowest were twelve and sixteen feet, others between twenty and thirty feet and the highest about forty-five feet from the ground. It is interesting to note that the third nest I investigated in 1936 was built on the same tree as that on which three years earlier I found my first nest. The trees selected for nesting purposes were the *simal* (Silk Cotton), *dhoka*, *ghar-nim* and another, of which I cannot now remember even the vernacular name.

Is it correct to state that the *frequent* return of the female to the nest gives away its whereabouts? And is it *only* the female that incubates? After watching the Crested Swift for many hours I should say that the female incubates for from forty to sixty minutes and the male from thirty to forty minutes at each sitting. While one is sitting the other is hawking for insects a mile or two away, or possibly further afield, at all events right out of sight, and it does not return to the neighbourhood of the nest until it is time to relieve its mate. After circling round once or twice it either flies directly on to the nest, the relieved bird almost invariably leaving as the other is about to alight, or settles on a neighbouring tree for a few seconds, or even a minute or two, before settling. As the nesting season of the Crested Swift is during the months of April, May and June, the hottest time of the year, when even the most ardent ornithologist requires to gird up his loins to go out into the sun, I do not think it can be stated with any degree of correctness that the *frequent* return of the female—or, for that matter the male—gives away the whereabouts of the nest. It is only the most careful watching of the birds with a pair of field-glasses, and that for a prolonged period, that is likely to bring success in this direction. And when the observer has finally seen a Crested Swift settle on some tree it does not necessarily follow that the bird is incubating. Even if it is, the nest is so small and its construction is such that from below it looks exactly like a knot in a branch, which is indeed what ninety-nine persons out of every one hundred would certainly imagine it to be.

One other point before I proceed to tell of the intimate life of the Crested Swift: Whistler, and for that matter Stuart Baker[1] is entirely wrong in stating that the parent bird sits across the nest and the branch to which it is attached so that the latter takes its weight. The statement might be taken to suggest that this is the *only* position adopted by the bird on the nest. In actual fact a Crested Swift may sit in *any* position when both incubating and brooding, although it is correct to say that about 65 per cent of the time is spent sitting in the manner described above. Much time is spent (by both sexes) in sitting on the nest itself, across the branch on to which it is built, or even parallel with it. It is by no means uncommon for a bird that started to brood with its body more or less on the branch and its breast feathers covering the far edge of the nest to end up by facing the branch after occupying almost every conceivable angle in between. I have photographed the bird in every position. It is the same with the young one who, however, spends most of the time sitting parallel with the branch.

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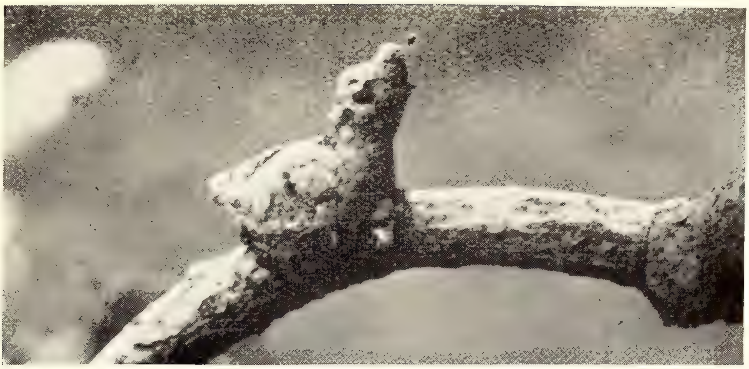
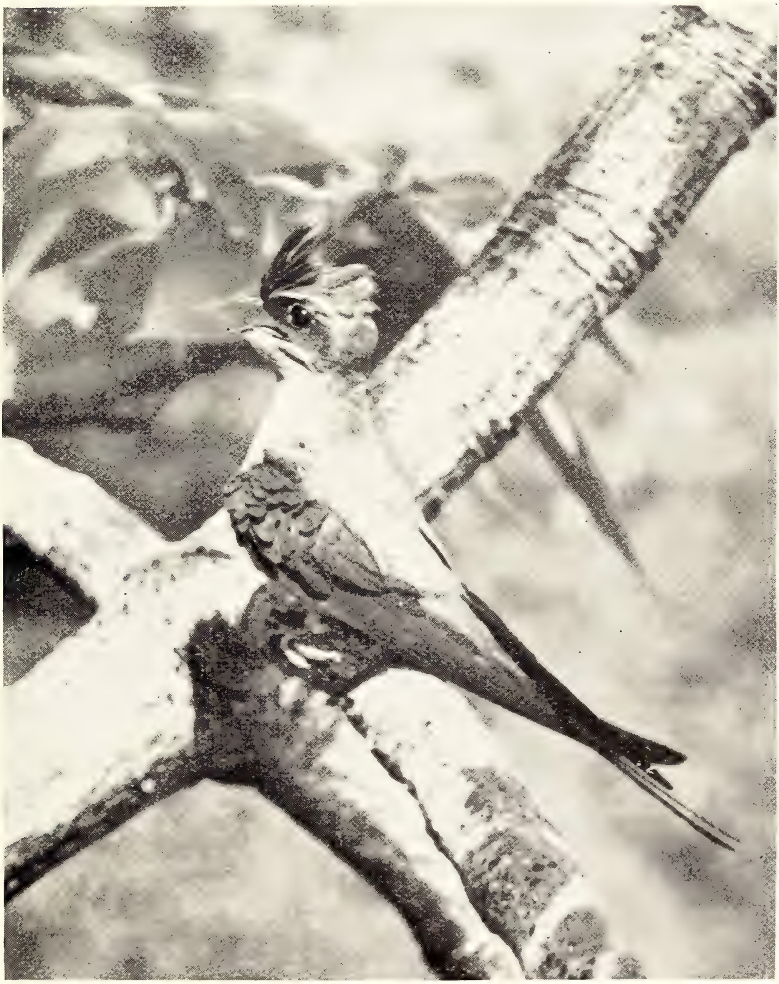
[1] *The New Fauna,* vol. iv, p. 355.

I have now photographed three different pairs of Crested Swifts at the nest but for the present let us return to the nest which I found on 13 April 1934. A *machan* was built beside and close to it the following day, and since the bird showed no fear, the *hide*, with a bottle protruding through the cloth, was introduced at the same time and remained in position overnight. I spent the whole of the 15th observing and photographing the birds, visiting the nest again for the same purpose on 20 April, 3, 6, 14, 25, 27 May and 1 June. During this time our acquaintance quickly ripened till, in the end, the parent birds fed the young regularly while I was seated beside the hiding-tent fully exposed to their view. On 20 April, however, the behaviour of the female was extraordinary. Just to see to what lengths I could go with the bird I slowly put my hand out towards her until I actually found myself passing my index finger through the feathers of her back, head and breast, tickling her really. She did not move a muscle, but when I put my little finger close to her beak she seized and shook it vigorously. No attempt did the bird make to leave the nest or even to alter her position on it. How I wished some friend might turn up to see us hob-nobbing in this extraordinary manner, to record by means of a camera the boldness shown by this brave heart in sticking to her post. It is interesting to relate that later (1 June) I handled the almost full-grown daughter (as I like to think she was) in exactly the same way and that she too shook my little finger as her mother had done before although (like mother) she did not object in the least to being tickled.

But to return: I had not been two minutes in the *hide* when the Crested Swift was back on the nest. What a beautiful picture she made as she sat there, bolt upright, only a few feet away from me, her pouting breast feathers covering almost half her tiny nest. With her gaze partially averted from me, she seemed confident that no living creature could possibly mean her any harm; and why have any fear for such an inanimate object as a *hide*? In my anxiety to make hay while the sun shone, so to speak, I took a number of photos of the bird, and then realising that the stance in each case was just the same, crawled out of the tent expecting the bird immediately to take flight, she remained on the nest perfectly immobile! Were all birds so easy to photograph at home as in this species, the sport simply would not be worthwhile. But more often than not the odds are against the



2. Half-grown Crested Swift.



Crested Swift brooding.

Photos by E. H. N. Lowther, 1934. *Copyright.*

photographer! As I exposed plate after plate on the bird, merely changing the stop or altering the exposure, my thoughts flew back to a Jungle Crow which I had tried to photograph at the nest and to a Water Rail in Kashmir whose picture I obtained after four days of patient trying. It is subjects such as these that make one appreciate more than ever the accommodating nonchalance of the Crested Swift. The actual photography may be easy but one has only to reflect to realise how great has been one's fortune for, not only is the finding of the nest no simple matter but to get close enough to photograph the Crested Swift at home is fraught with obstacles sufficiently formidable to deter all but the keenest devotees of the camera.

Having obtained all the photographs I could take I devoted the rest of the day to observing the birds. In this particular instance the female was the more confiding, the male refusing to come to the nest while I was on the *machan* exposed to his gaze. When, however, I remained concealed, or sat quietly near the tree, he displayed no reluctance, and although ready to leave the nest when I climbed the tree again, he sat sufficiently close to allow me to photograph him. The female's temperament was very different; she literally had to be *pushed* off so that I could inspect the nest and egg carefully. It was then I noted that the wall of the nest was a quarter of an inch or so higher than the upper surface of the branch and extended right on to the branch the flakes of the bark forming an almost complete oval. Such an arrangement undoubtedly helps to prevent the young bird from falling out of the nest. This wall was common to all the nests which I inspected.

It is not always the female who is the more confiding. In the case of the first pair I photographed in 1936, the female was far bolder during the incubation period, but after the egg hatched she would seldom venture to the nest while I was on the *machan*, whereas the male who previously never quite trusted me now was every bit as bold as his mate had been previously—more so in fact. Both had literally and truly to be *pushed* off the nest to enable me to see the egg or young. It was just the reverse with the second pair I photographed in the same year. The male sat closely when incubating, when the female would not venture to the nest while the camera's cold eye stared at her. When the egg had hatched the positions were completely reversed. They too let me touch them and seized my finger when placed near their beaks. As in the case of the other Crested Swifts I had previously photographed it was almost impossible to dislodge this pair from the nest; it is no exaggeration to say that they had to be *removed* from it.

During the first fortnight of its life the young Crested Swift is seldom left unattended by its parents; one broods while the other is absent looking for food. As the latter arrives the first leaves the nest. When this 'change-over' is taking place, when the young bird is aware that it is going to be fed, its behaviour is most peculiar—it sinks down gradually into the nest as though it were going to be courted, much in the same way that pigeons behave, Then the parent bird throws its head up with the beak pointing to the skies and looks as though it were going to expectorate; actually the bird is bringing up food. It is only when this movement takes place that the young one holds up its head, the parent putting its beak inside the young one's to feed it. This feeding lasts for about one second only and is accompanied by a minimum of movement and no calling on the part of either parent or child, the latter subsequently sheltering close to or under the adult bird's body. Although what the youngster received always seemed to me to be a thoroughly inadequate meal never did I see it receive food a second time in the same visit, nor by voice or deed did it suggest that it wanted more. On an average it was fed every twenty or twenty-five minutes.

Between the age of two and three weeks the crest becomes prominent in the young and its plumage takes on an ashy-grey colour, with dark-brown patches by the base of the crest, near the eye and on the wings so that the nest and young bird assimilate with their surroundings in a remarkable manner. A week later the general colouring of the plumage is a 'pepper and salt', this pattern making it even more difficult to distinguish the young Crested Swift from its surroundings. I was not surprised therefore to note that at this stage the parents no longer brooded except when it rained or a high wind was blowing. On such occasions the young one caused the male bird considerable uneasiness by the way in which it kept turning round from side to side or stretching its baby pinions. More than once it seemed as though the parent would be knocked off the nest. When, however, the young bird remained quiet for a few seconds the male would puff out his breast and side feathers until it appeared that he was wearing a cape.

Such has been my last glimpse of the three-quarters grown Crested Swift and its parent at three different nests as I packed up camera and tripod and then supervised the dismantling of the *machan*. It is not difficult to enter into the feelings of the egg-collector when he has found and taken the nest and egg of a Crested Swift. I am sure, however, that he will be the first to admit the infinitely greater happiness and pride of the cameraman who has refrained from even touching the egg and has in the fulness of time reaped his reward in observing the young bird grow up, noted the home life of the species and finally secured a large series of photographs to remind him always of pleasant days spent with 'good companions'.

THE NESTING OF THE INDIAN CRESTED SWIFT (*HEMIPROCNE CORONATA*) IN UPPER BURMA.

BY

J. K. Stanford, i.c.s. and H. C. Smith, i.f.s.

On March 28, 1936, we found in the Pidaung Game Sanctuary of the Myitkyina District a nest of *Hemiprocne coronata* which offered remarkable opportunities for photography. The nest was in a small and almost leafless *Lettok* tree (*Holarrhena antidysenterica*) growing on a grassy plain, and was situated at a height of about 20 ft. from the ground. But for seeing the bird sitting the nest could hardly have been detected from below. The bird was remarkably tame and allowed us to walk under the nest and observe it at very close range, so on the 29th H. C. Smith stalked it with a camera and spent over an hour photographing it from the ground with a 17-inch Teleros lens in a Soho Reflex camera set up on a stand. After the first half hour, the bird refused to leave the nest and sat motionless except for turning its head and erecting its crest when anyone came too close under the branch. As is well known, the Indian Crested Swift incubates while perching upright on a branch with the body and tail on the far side from the nest and the breast feathers projected over the egg. Perched thus with the long wings crossed, and the narrow tail dependent between them, the bird presented a most unique and beautiful appearance as its chestnut-red cheeks and ashy-grey underplumage gleamed in the sun. From the level of the nest, the egg appeared to project well over the shallow rim of the saucer-like structure. We examined the nest after the young one had departed and it measured 47 × 30 mm. and at its centre was 11 mm. in depth. It was composed almost entirely of scales or flakes of bark gummed together with saliva in such a way that the outer layers overlapped somewhat after the manner of the scales of a fircone. The nest was attached to the eastern side of the branch which at that point measured roughly 50 mm. in circumference and was growing horizontally from north to south; the sitting bird therefore had its back to the afternoon sun. The nest was so shallow that presumably the egg would have been blown out unless covered by the bird during the sudden gales which sweep this district at all seasons of the year. The male spent most of the time sitting on a tree nearby and we considered that he took part in incubation. When together, the two were easily distinguishable by the deeper colour of the cheeks in the male and this was very noticeable on one occasion when the sitting bird was observed.

On April 26, J. K. Stanford re-visited the nest on two occasions with Major Byrne and a game keeper. The young bird was well feathered and sitting like the adult, more or less upright with head and neck extended, crest raised and beak pointing slightly skywards. The colouration, shape and attitude were so extraordinarily protective that the game keeper declined to believe it was a bird at all and had to climb the tree to satisfy himself. (Even his companions had some doubt at first although they were using Zeiss glasses at a range of about 25-30 ft.!) On the first occasion the nestling was sitting on the nest, parallel with the branch, later in the afternoon it was sitting across the branch, so that the short tail was just visible on the other side of the branch from the nest. The shape of the head and drawn-out appearance of the neck were most remarkable and the youngster appeared much more like a chameleon than a bird. The outline of the crown behind the crest seemed to form almost a straight line slanting to a point at the nape.

On April 29, J. K. Stanford again visited the nest with Major Byrne and Mr. D. P. Lister, B.F.S. Kodak photography without a telephoto lens proved a failure and after several attempts Mr. Lister produced a sketch which shows clearly the remarkable similarity of the young bird to a Nightjar. (This, we may say is well-illustrated by one of the photographs reproduced in Mr. H. Whistler's article on the nesting of the Crested Swifts in volume xxxiv of the Society's *Journal*, page 772.) The shape of the young bird's head had by that time altered considerably, but we all agreed that it bore no resemblance whatever to the shape of the head in the adults, which we could observe at a few yards' range as they sat on a tree nearby. The chameleon-like appearance was still most pronounced, and the young bird sat like a Nightjar along the branch with head and neck raised, beak pointing upwards and gape slightly open. In this phase of juvenile plumage, the mottled colouring also suggests a Nightjar much more strongly than a Swift.

The crest plumes, as far as could be seen with glasses at very close range, were in quill and quite stiff, in profile each feather being sharply divided from the next.

This bird was last seen on May 2nd, still on the branch but no longer on the nest; it had disappeared next day.

Photographs of the young being fed in its later stages of development would be of very great interest, and, judging by our experience in this case, should not be difficult to obtain.

THE MEDICINAL AND POISONOUS AROIDS OF INDIA.

BY

J. F. Caius, s.j., f.l.s.

The Araceae include about 107 genera with over 1,000 species, most of which are natives of tropical regions and the rest of temperate regions, in both hemispheres. Most of them contain an acrid juice, which is sometimes highly irritating and poisonous.

The medicinal and poisonous Aroids of the world belong to 42 genera:—Acorus (northern temperate regions, South-Eastern Asia); Aglaonema (Tropical Asia and Africa); Alocasia (Tropical Asia); Amorphophallus (Tropical Asia and Africa); Anadendrum (Malaya); Anchomanes (Tropical Africa); Anthurium (West Indies, Central and Southern America); Arisaema (Asia, Abyssinia, America); Arisarum (Mediterranean region); Arum (Europe, Northern Africa, Western Asia); Biarum (Asia Minor, Syria, Northern Africa); Caladium (South America, Indo-Malaya); Calla (Europe, Northern Asia and America, Philippine Islands); Colocasia (Tropical Asia); Cryptocoryne (Indo-Malaya); Culcasia (Tropical Africa); Dieffenbachia (Central and South America, Japan); Dracontium (South America, Java); Dracunculus (South Europe, Canary Islands); Epipremnum (Malaya, Polynesia); Homalomena (Asia, South America); Lagenandra (India, Ceylon); Lasia (Indo-Malaya); Monstera (Tropical America); Montrichardia (Tropical America); Orontium (Northern America); Philodendron (Tropical America); Pinellia (China, Japan); Pistia (Tropics and subtropics except Polynesia and Macronesia); Plesmonium (India); Pothos (Indo-Malaya, Madagascar); Remusatia (Tropical Africa, Indo-Malaya); Rhaphidophora (Indo-Malaya); Richardia (Southern Africa); Sauromatum (palaeotropics); Scindapsus (Indo-Malaya); Stylochiton (Tropical and Southern Africa); Symplocarpus (Northern America); Synantherias (Southern India, Ceylon); Typhonium (Indo-Malaya); Typhonodorum (Madagascar); Xanthosoma (West Indies, Tropical America).

The medicinal and poisonous Aroids of India belong to 21 genera:—Acorus, Aglaonema, Alocasia, Amorphophallus, Anadendrum, Arisaema, Colocasia, Cryptocoryne, Epipremnum, Homalomena, Lagenandra, Lasia, Pistia, Plesmonium, Pothos, Remusatia, Rhaphidophora, Sauromatum, Scindapsus, Synantherias, Typhonium.

I. Spadix with or without an appendage.
A. Leaves entire or lobed. Stamens free; ovary 1-celled; ovules orthotropous.
1. Spadix appendaged.
a. Marsh herbs. Ovaries spirally disposed ... Lagenandra.
b. Terrestrial tuberous herbs.
i. Leaves compressed, lobed ... ... Arisaema.
ii. Leaves pedatipartite, appearing after the flowering ... ... Sauromatum.
iii. Leaves ovate or lobed, coetaneous with the flowers ... ... Typhonium.

2. Spadix without an appendage.
  a. Floating stemless herb; leaves obovate ... Pistia.
  b. Submerged or aquatic herbs; leaves ovate or lanceolate ... ... Cryptocoryne.
B. Tuberous herbs large. Leaves appearing without flowers, solitary, very large, 3-lobed or pinnatisect. Ovules anatropous.
  1. Spadix without an appendage; neuters very large Plesmonium.
  2. Spadix appendaged.
    a. Appendage large, naked; neuters absent ... Amorphophallus.
    b. Appendage slender, naked; neuters below the male ... ... Synantherias.
C. Herbs not tuberous; stem creeping, erect or subterranean. Leaves undivided, cordate or peltate.
  1. Limb of spathe refracted, open; ovules parietal. Remusatia.
  2. Limb of spathe erect.
    a. Ovules many, parietal; fruit subcapsular ... Colocasia.
    b. Ovules few, basal; fruit drupaceous, red ... Alocasia.

II. Spadix without an appendage.
A. Flowers monoecious. Perennial herbs, flowering and leafing at the same time. Spadix shorter than the spathe. Fruit enclosed in the spathe tube.
  1. Spathe eventually deciduous; fruit a red drupe. Aglaonema.
  2. Spathe persistent; fruits very small, not drupaceous or red ... ... Homalomena.
B. Flowers bisexual.
  1. Climbers often woody.
    a. Perianth none, or a thin semicircular limb.
      i. Drupes distinct, red ... ... Anadendrum.
      ii. Fruits crowded, not drupaceous or red.
        ¶ Ovary 1-celled, 1-seeded. Leaves ovate to oblong-lanceolate entire ... ... Scindapsus.
        ¶¶ Ovary 1-2-celled, many-ovuled. Berries confluent. Seeds oblong ... ... Rhaphidophora.
        ¶¶¶ Ovary 1-celled, 1-seeded. Leaves entire or lobed. Seeds kidney-shaped ... ... Epipremnum.
    b. Perianth lobes 6. Spadix flowering upwards. Leaves distichous ... ... Pothos.
  2. Large marsh plant with stout stem, prickly erect. Spadix, much shorter than the long spathe, flowering downwards, sessile. Leaves lobed. Lasia.
  3. Stemless rhizomatous plant; rhizome aromatic. Leaves ensiform. Spathe none ... ... Acorus.

Acorus.

The genus consists of 2 species, inhabiting the northern temperate regions and South-Eastern Asia.

A. calamus Linn. is used medicinally in India, Malaya, Indo-China, China, Europe and South Africa; *A. gramineus* Soland in Malaya, Indo-China and China.

Midrib of leaves stout ... ... 1. *A. calamus.*
Midrib of leaves absent ... ... 2. *A. gramineus.*

1. Acorus calamus Linn. is found throughout India and Ceylon, in marshes, wild or cultivated, ascending the Himalaya up to 6,000 ft. in Sikkim. It occurs in all European countries except Spain, and becomes more abundant eastwards and in Southern Russia, Northern Asia Minor and Southern Siberia, China and Japan, Indo-China and Malaya. It is also met with in the

Northern United States of America, where it appears to be indigenous.

The rhizome is described in the Nighantas as pungent, bitter, heating; emetic, laxative, diuretic, carminative, anthelmintic; improves appetite, voice, throat; good for diseases of the mouth; useful in abdominal pains, inflammations, fevers, epilepsy, bronchitis, delirium, hysteria, dysentery, tumours, thirst, loss of memory, rat-bite, worms in the ear.

According to Mahommedan writers the rhizome has a very bitter sharp taste; it is laxative, expectorant, carminative, alexiteric, tonic to the brain, emmenagogue; useful in general weakness, stomatitis, toothache, inflammations, pains in the liver and the chest, kidney troubles, leucoderma.

The aromatic rhizome or rootstock is considered emetic in large doses, and stomachic and carminative in smaller doses. It is a simple useful remedy for flatulence, colic or dyspepsia, and a pleasant adjunct to tonic or purgative medicines. It is also used in remittent fevers and ague by the native doctors, and is held in high esteem as an insectifuge, especially for fleas.

The root has been employed in medicine since the time of Hippocrates. By the moderns it is successfully used in intermittent fevers, even after Cinchona bark has failed, and it is certainly a very useful addition to Cinchona. It is also a useful adjunct to bitter and stomachic infusions.

It is commonly used to allay distressing cough. A small piece of the dried rootstock kept in the mouth acts better than many cough lozenges. It produces a warm sensation in the mouth and a beneficial flow of saliva. The candied root is sold as a favourite medicine in every Indian bazaar. The Indians of the Hudson's Bay Territory also use the rootstock as a cough medicine.

The Mundas of Chota Nagpur apply the ground rhizomes to the cranial suture of feverish babies.

In Ceylon the rootstock is used in bowel complaints. It has been found extremely useful in the dysentery of children, and also in bronchitic affections. The Europeans of South Africa use it as a carminative and as a diarrhoea remedy.

The Meskwaki Indians of Wisconsin use it as a physic, and in combination with other medicines as a cure for burns, while the Menomini give it for cramps in the stomach.

The root is supposed by the Chinese to affect the heart and lungs and to be beneficial for cancer. In general it is taken as a restorative for the body and spirits.

Culpeper says: 'The spicy bitterness of the root of this plant bespeaks it as a strengthener of the stomach and head, and therefore may fitly be put into any composition of that intention. The root preserved may with good success be used by itself, and both the Germans and Turks are very fond of it, and reckon it a great preservative against infectious air, which makes them commonly eat a piece of the preserved root fasting.'

Even nowadays the candied rhizome is widely employed in Europe, and the Turks use it as a preservative against contagion.

Moodeen Sheriff experimented with the drug and wrote: 'The rhizome is emetic, nauseant, antispasmodic, carminative, stimulant and insecticide. As an emetic it is more nauseant and depressant than Ipecacuanha, and it is therefore useful in most of the diseases in which the latter is indicated, including dysentery. It is one of the two vegetable drugs in this country which act efficiently as emetics in so small a dose as 30 grains. It should not be used in more than 35 grains, and in 40 grains its action is very violent and obstinate. It is a good remedy in asthma, to relieve which, it should be first used in pretty large or nauseant doses (15 to 20 grains) and then repeated every 2 or 3 hours in smaller or expectorant doses (10 grains) till relieved. Among other diseases which are most benefited by this drug are bronchial catarrh, hysteria, neuralgia and some forms of dyspepsia. The rhizome can also be used in the form of a tincture or an infusion.'

Later Koman gave a decoction to several patients suffering from indigestion and found it to be efficacious.

The rhizome is officinal in Austria, Germany, Holland, Hungary, Italy, Norway, Portugal, Russia, Sweden and Switzerland.

Caius and Mhaskar have found the rhizome useless for the antidotal treatment of snake bite and scorpion sting.

Afrikaans: Kalmoes—; *Annam*: Thach xuong bo, Xuong bo—; *Arabic*: Vaj, Vash—; *Assam*: Bach—; *Bengal*: Bach, Shwetbach—; *Burma*: Linhe—; *Canarese*: Baje—; *Chinese*: Che Ts'ang Pou, Choui Ts'ang Pou, Pai Ch'ang, Ts'ang P'ou—; *Cutch*: Vekhanda—; *Deccan*: Gandkilakri, Vach—; *Dutch*: Kalmus, Zwanenbrood—; *English*: Bastard Water Flag, Calamus, Cinnamon Sedge, Myrtle Grass, Myrtle Sedge, Sweet Cane, Sweet Flag, Sweet Myrtle, Sweet Root, Sweet Rush—; *French*: Acore, Acore aromatique, Acore odorant, Acore vrai, Acori, Acrois, Galanga des marais, Roseau aromatique, Roseau odorant—; *German*: Ackermagen, Deutscher Ingber, Gewuerzkalmus, Kalmus, Karmes, Karmsen, Kaumeles, Kolmas, Magenwurz, Nagenwurz, Schiemen, Schienenzurz, Wechel, Zehrwurz—; *Gujerati*: Gandhilovaj, Godavaj, Vekhand—; *Hindi*: Bach, Ghorbach, Gorbach, Igir, Kussebbewa—; *Italian*: Acoro, Acoro aromatico, Acoro odoroso, Calamo, Calamo aromatico, Canna odorifera, Erba cannella, Erba di Venere, Erba venerea—; *Jhalawan*: Kull—; *Kashmir*: Vahi—; *Malaya*: Cheong fu, Deringu, Jeringu—; *Malayalam*: Vashampa—; *Marathi*: Vekhand—; *Menomini*: Apaxkiu utcipa, Enausapokotcikun, Weke, Wiabiskitcipa kakasapotcikun—; *Meskwaki*: Mishinepisuni—; *Mundari*: Otehajam—; *Norfolk*: Gladdon—; *Norwegian*: Kalmus—; *Pacific Coast*: Beewort, Calamus-root, Flag-root, Myrtle Flag, Sweet Cane, Sweet Cinnamon, Sweet Flag, Sweet Myrtle—; *Pampangan*: Bueng—; *Persian*: Agar, Agreturki—; *Portuguese*: Calamo aromatico, Canna cheirosa—; *Prairie Potawatomi*: Sinipisiwun—; *Punjab*: Bariboj, Wach—; *Roumanian*: Spervian—; *Sanskrit*: Bhadra, Bhutanashini, Bodhaniya, Galani, Golomi, Ikshuparni, Jalaja, Jatila, Kanga, Kshudraptri, Lomasha, Mangalya, Rakshoghni, Shadagrantha, Shataparvika, Schleshmaghni, Smarani, Tikshna, Tikshnapatra, Ugra, Ugragandha, Vacha, Vijaya—; *Sinhalese*: Wadakaha, Wadakahavasambu—; *South Africa*: Myrtle Flag, Sweet Flag, Sweet Sedge—; *Spanish*: Acoro, Acoro verdadero—; *Swedish*: Kalmus—; *Tagalog*: Lubigan—; *Tamil*: Vashambu—; *Telugu*: Vadaja, Vasa, Wasa—; *Urdu*: Bacha—.

2. **Acorus gramineus** Soland occurs in the Sikkim Himalaya up to 6,000 ft., and in the Khasia Hills. It extends to China and Japan.

The root has stimulant, tonic, antispasmodic properties, and is used in China as a diaphoretic, an insectifuge and an insecticide. In Cochin-China it is considered a good substitute for Sweet Flag.

Annam: Thach truong bo—; *Chinese*: Ch'ang P'u, Shih Ch'ang P'u, Shui Ch'ang P'u, Wai Ch'ang P'u—; *Malaya*: Soi cheong phoo—.

AGLAONEMA.

The genus includes about 20 species, Tropical Asiatic and African.

Aglaonema angustifolium N. E. Br. var. **undulatum** Ridl. is found in the Malay Peninsula, where the natives use a decoction of the roots for fever and dropsy.

Malay: Penggehe, Sagut, Sumpuh bulau, Sumpuh kring—.

ALOCASIA.

The genus numbers 45 species, found in Tropical Asia.

A.	Leaves broadly ovate-cordate, repand, nerves 5-6 pairs; petiole short stout	4. *A. montana.*
B.	Leaves large ovate, deeply sagittately cordate, repand; petiole stout, transversely clouded ...	2. *A. indica.*
C.	Leaves triangular-sagittate, shortly acuminate, about $\frac{1}{3}$ as broad as long; petiole long slender ...	1. *A. denudata.*
D.	Leaves broadly ovate-sagittate, repand; basal lobes rounded, connate for $\frac{1}{10}$th of their length; petiole 2-4 ft., base sometimes as thick as the arm ...	3. *A. macrorrhiza.*

1. **Alocasia denudata** Engl. (=*A. singaporensis* Linden) is common in hedges and woods all over the Malay Peninsula, extending to Lingga and Borneo.

The acrid juice is used as a poison in Kelantan.

Malay: Berar kitan, Keladi chandek, Keladi rimau, Keladi ular.

2. **Alocasia indica** Schott is cultivated in India and in most parts of the tropics.

Sanskrit writers describe the rootstock as pungent, fragrant, cooling; useful in inflammations, leprosy, anasarca, diseases of the abdomen and spleen.

Medicinally it is said to be useful in anasarca. The flour obtained by pounding the dried stems boiled with rice flour until all the water has evaporated, is given to the patient, and no other food allowed except milk. The ash, mixed with honey, is used in cases of aphthae.

As a food taken frequently, it seems to act as a mild laxative and diuretic. In piles and habitual constipation it is useful.

The tubers chopped fine, tied in a cloth and heated, are used as a fomentation in rheumatism.

The acrid juice of the petioles is much used as a common domestic remedy on account of its styptic and astringent properties. The petiole is slightly roasted and the juice expressed. Purulent discharge from the ears in children is often stopped by a single application.

The juice of the fresh petiole has no action in the symptomatic treatment of scorpion sting (Caius and Mhaskar).

Assam: Mankachu—; *Bengali*: Manguri, Mankachu—; *Betsimisaraka*: Saombia—; *Canarese*: Manaka—; *English*: Acrid Taro, Giant Taro—; *Fiji*: Dranu, Via—; *Goa*: Curcas—; *Guam*: Piga—; *Hindi*: Mankanda, Mankandu, Mankashu, Manna—; *Malay*: Birah, Keladi sebaring—; *Marathi*: Alu—; *Mundari*: Mansaru—; *Philippines*: Biga, Elephant's Ears—; *Samoa*: Ape, Ta'amu—; *Sanskrit*: Brihachhada, Chhatrapatra, Mahapatra, Mana, Manaka, Sthalapadma, Vistirnaparna—; *Sinhalese*: Rata-ala—; *Tagalog*: Badiang, Gabingonac—; *Visayan*: Badiang—.

3. **Alocasia macrorrhiza** Schott is found wild and cultivated throughout tropical and subtropical India. It is cultivated in the tropics generally.

The root is a mild laxative and diuretic.

It is numbered among the recorded fish-poison plants in Australia. The milky juice of the lower part of the stem is used in Queensland as an antidote to the stings of *Laportea gigas* Wedd., the Giant Nettle.

Chinese: Hai Yu—; *English*: Acrid Taro, Giant Taro—; *Easter Island*: Kape—; *Guam*: Piga—; *Hawaii*: Ape, Apü—; *New Caledonia*: Alendiete, Baouen, Diamote, Ouagan, Pera, Taro—; *Philippines*: Biga—; *Queensland*: Banganga, Bargadga, Cunjevoi, Hakkin, Nargan, Pitchu—; *Rarotonga*: Kape—; *Samoa*: Ape, Ta'amu—; *Sinhalese*: Habarala—; *Tahiti*: Ape—.

4. **Alocasia montana** Schott occurs in the Northern Circars, and has been found in Java.

The root is said to be used to poison tigers (Roxburgh).

AMORPHOPHALLUS.

This genus includes about 90 species, spread over tropical Asia and Africa.

A. rivieri Durieu is used medicinally in China; *A. dracontioides* N. E. Br., *A. flavovirens* N. E. Br., and *A. johnsonii* N. E. Br. are used in the Gold Coast

Style many times longer than the ovary	1. *A. campanulatus.*
Style absent	2. *A. prainii.*

1. **Amorphophallus campanulatus** (Roxb.) Bl. is largely cultivated throughout the plains of India and Ceylon. It occurs in open pastures, in grassy fields, and on the borders of woods all over the Malay Peninsula, whence it extends to Siam, Sumatra, Java and the Andamans.

Sanskrit writers describe the tuber as dry, acrid, pungent; increasing both appetite and taste; stomachic, constipating; useful in piles, enlargement of the spleen, tumours, asthma, bronchitis, vomiting, abdominal pain, blood diseases, elephantiasis; causes itching sensation; harmful in leprosy, leucoderma. The tuber is covered with a layer of earth, roasted in hot ashes, and administered with the addition of oil and salt. Several confections are also used. The dried tubers, peeled and cut into segments, are sold in the shops.

The corm and the seeds are used as irritants and relieve the pain of rheumatic swellings when applied externally. The corm is considered a hot carminative in the form of a pickle. The tuber contains a large quantity of farinaceous matter, mixed with acrid poisonous juice, which may be extracted by washing or heat. When fresh, it acts as an acrid stimulant and expectorant, and is used in acute rheumatism. It is supposed to have restorative powers and is in much request. It is considered serviceable in haemorrhoids.

The root is used in ophthalmia and applied to boils. It is also used as an emmenagogue.

The raw tuber, well ground, is rubbed on swellings of the extremities by the Mundas of Chota Nagpur. If eaten, it produces unbearable itching in the mouth and throat, and it may prove fatal.

Bengal: Ol—; *Bombay*: Janglisuran—; *Burma*: Wa—; *Cagayan*: Bagang—; *Cutch*: Janglisuran—; *Deccan*: Kanda—; *Hasada*: Hada, Hatuhada—; *Hindi*: Kanda, Ol, Zaminkand—; *Ilocano*: Carot, Corot—; *Jolo*: Bagong—; *Kolami*: Ol—; *Konkani*: Suma, Surna—; *Malayalam*: Karunakarang—; *Marathi*: Suran—; *Matheran*: Suran—; *Naguri*: Haluhada, Ol—; *Persian*: Zaminkand—; *Punjab*: Nagphannigand, Zamin gand—; *Sanskrit*: Arsaghna, Arshoghna, Bahukanda, Durnamari, Kanda, Kandala, Kandarha, Kandashurana, Kandi, Kandula, Kandvardhana, Kanthalla, Olla, Rutchyakanda, Sthulakandaka, Sukandi, Suvitra, Tivrakantha, Vatari—; *Tagalog*: Apon, Pungapung, Tocodlangit—; *Tamil*: Karunaikkalang, Karunaikkilhangu—; *Telugu*: Daradakandagadda, Ghemikanda, Kanda, Kandagodda, Manchikanda, Polikanda—; *Uriya*: Olna—; *Visayan*: Anto, Oroy, Pamangguilon, Pungapung, Tocodlangit—.

2. **Amorphophallus prainii** Hook. fil. is common in the forests of the Malay Peninsula, especially by the forest paths. It extends to Sumatra.

The acrid juice is used as a poison by the Malays. Mixed with *Antiaris* latex it is one of the Sakai dart poisons.

Malay: Sikir, Loki, Lokie—; *Sakai*: Begung—.

ANADENDRUM.

The genus consists of 4 or 5 Malayan species.

Anadendrum montanum Schott var. **longirostris** Hook. fil. is common in the Malay Peninsula, where it is found in the low country growing low down on tree trunks in thick forest. It extends to Tenasserim, Java and Borneo.

The roots are used medicinally by the Malays.

Malay: Akar asam tebing darat, Akar merayan, Akar sugunja, Akar cumbung—.

ARISAEMA.

The genus includes 105 species, inhabiting Asia, Abyssinia and America.

A. japonicum Schott, *A. ringens* Schott, *A. thunbergii* Blume are used medicinally in China; *A. thunbergii* Blume is used in Indo-China; *A. triphyllum* Schott in North America.

A.	Leaves trifoliolate. Limb of spathe ovate-lanceolate, incurved caudate-acuminate	2. *A. speciosum.*
B.	Leaves pedatisect. Limb of spathe incurved, broadly cymbiform, acuminate	3. *A. tortuosum.*
C.	Leaflets whorled. Limb of spathe suberect, cymbiform, long caudate-acuminate	1. *A. leschenaultii.*

1. **Arisaema leschenaultii** Blume is found in the Nilgiris, Travancore and Ceylon.

The roots are used medicinally by the Sinhalese.

Sinhalese: Walkidaran—.

2. **Arisaema speciosum** Mart. occurs in the temperate Himalaya from Kumaon to Sikkim and Bhutan.

In Hazara, the root is stated to be poisonous; in Chumba, it is applied pounded to snake-bites. In Kulu, where the tuber is given to sheep for colic, the fruit is said to have deleterious effects on the mouth when eaten by children.

The root is not an antidote to snake venom (Mhaskar and Caius).

Punjab: Kiralu, Kirikikukri, Sampkikhumb—; *Sinhalese*: Walkidaran—.

3. **Arisaema tortuosum** Schott is found in the Sikkim Himalaya, Manipur, Bengal and the Western Peninsula.

It is stated to have poisonous qualities. In Kulu, the seeds are said to be given with salt for colic in sheep. The roots are used to kill the worms which infest cattle in the rains.

Kharwar: Dain—; *Nepal*: Birbanka—; *Punjab*: Don, Gurin, Jangosh, Kirakal, Kirkichalu—; *Santali*: Tuyajondra—.

COLOCASIA.

The genus numbers 7 species, natives of tropical Asia, one of which is cultivated or naturalised in many subtropical countries.

Colocasia esculenta (Linn.) Schott (=*C. antiquorum* Schott) is found wild and cultivated throughout the hotter parts of India and Ceylon. It is cultivated in all hot countries.

The pressed juice of the petioles is styptic, and may be used to arrest arterial haemorrhage. It is sometimes used in earache and otorrhoea, and also as an external stimulant and rubefacient. The juice expressed from the leaf-stalks is used with salt as an absorbent in cases of inflamed glands and buboes. The juice of the corm is used in cases of alopaecia. Internally, it acts as a laxative, and is used in cases of piles and congestion of the portal system, also as an antidote to the stings of wasps and other insects. The tubers chopped fine, tied in a cloth and heated, are used as a fomentation in rheumatism.

The corm is used by the Mundas as a remedy for body-ache.

Caius and Mhaskar have demonstrated that the juice of the corm is without action in the symptomatic treatment of scorpion sting.

Accra: Mankani—; *Angami Naga*: Dzu, Kirth—; *Annam*: Khoai nuoc—; *Arabic*: Kalkas, Kur, Gulgas—; *Ashanti*: Kooko—; *Bengal*: Ashukuchu, Bunkuchu, Charkuchu, Guri, Kachhu, Kachu, Kalokuchu, Kuchu—; *Bombay*: Kachualu, Terem—; *Brazil*: Tayoba de São Thome—; *Burma*: Mahuyapein—; *Cagayan*: Gabi—; *Canarese*: Kesavedantu, Keshavanagadde, Shamegadde—; *Carolines*: Chaua—; *Chinese*: Yu, Yu T'eou—; *Cuba*: Malanga—; *Deccan*: Arvi, Chamkurekagaddah—; *Egypt*: Culcas, Kolkus, Golkas—; *English*: China Potato, Coco, Coco Yam, Eddoes, Egyptian Arum, Kopeh, Scratch Coco, Taro—; *Fanti*: Kooko, Mankani—; *Fiji*: Taro—; *French*: Chou caraïbe, Colocase, Colocasie, Gingembre d'Egypte—; *Fufulde*: Tandauje—; *Gold Coast*: Coco Yam—; *Guam*: Sune, Suni—; *Hausa*: Gwaza, Kamu, Koko yam—; *Hindi*: Arvi, Arwi, Ashukachu, Auri, Avois, Gagli, Ghoya, Ghuian, Ghuiya, Ghuya, Ghwiya, Gorikachu, Kachalu, Kachalu arvi, Kachu—; *Japanese*: Aka-imo, Imo, Midsu-imo, To-no-imo—; *Kangra*: Arbi, Gandiali, Kachalu—; *Khasi*; Ka shiriw—; *Kolami*; Pichgisaru—; *Konkani*; Allum—; *Languedoc*;

Farrao—; *Le Reunion*: Songe, Songe du pays, Sonze de Chine, Sonze de Maurice, Sonze noire, Sonze du pays—; *Lynngam*: Chew—; *Madagascar*: Songe—; *Malay*: Keladi china, Keladi hudang, Keladi telor—; *Malayalam*: Chempakizhanna, Kaladi—; *Malta*: Coco, Cocoaroot, Colocasia, Aro di Egitto, Ghorghas—; *Marathi*: Alu—; *Marquesas*: Tao—; *Mexico*: Quequexquic, Quequeste—; *Mundari*: Birsaru, Kucusaru—; *New Caledonia*: Barenik, Coboué, Dadi, Diali, Diamboilaté, Doboua, Jabouak, Jalapé, Kandié, Kandiéren, Kavé, Kiamoan, Néré, Ouagapé, Ouaoua, Oumon, Ounégaté, Paricraouté, Pobo, Tanmaouté, Taro, Tianaboué, Tiaouné, Tiréné—; *Pampangan*: Gabi, Gandus, Gavay, Lagway—; *Panama*: Oto—; *Philippines*: Badiang, Dagmay—; *Polynesia*: Kalo, Talo, Taro—; *Porto-Rico*: Yautia malanga—; *Punjab*: Alu, Gagli, Ghuyan, Givian, Kachalu, Kachalu arbi, Kasauri, Rab—; *Sadani*: Bonsaru—; *Sanskrit*: Kachchi, Kachu, Kachwi—; *Sema Naga*: A'i—; *Singapore*: Gahala, Tadala—; *Sinhalese*: Gahala, Habarala, Kandala, Tadala—; *South Carolina*: Carib Cabbage—; *Spanish*: Aro de Egipto, Name de Canarias, Name de Egipto, Yame de Canarias, Yame de Egipto—; *Sunda*: Talas, Taloes—; *Tagalog*: Gabi, Gabingpola, Gabingsilangan, Gabynasiboyas, Gabynasiniboyas, Gandus, Gavay, Lagvay—; *Tamil*: Shamakkilangu, Shemakkalenga—; *Telugu*: Chamadumpa, Chamagadda, Chamakura, Chamakuru, Chema, Shamathumpa—; *Twi*: Kooko—; *Uriya*: Saru—; *Visayan*: Abalong, Apipi, Biga, Dagmayngaapipi, Dagmayngabolilao, Dafimayngainitlog, Dagmayngaquinson, Dagmayngatapol, Gabi, Gabingmorada, Ganyngaguinatos, Galiang, Gandus, Gavay, Guinatos, Lagway, Quimpoy—; *West Africa*: Coco Yam—; *West Indies*: Coco, Eddo, Eddoes, Dasheen, Tania, Tanier—; *Yoruba*: Koko—.

CRYPTOCORYNE.

The genus consists of 40 Indo-Malayan species.

Cryptocoryne spiralis Fisch occurs from Khandesh to North Kanara, Calicut, Coromandel, Ceylon and Bengal.

It is a well-known drug in Ceylon, where it is employed by the native doctors in decoctions, in combination with other drugs as a remedy for infantile vomiting and cough, and in the case of adults for abdominal complaints and fever.

The plant is considered a substitute for Ipecacuanha. It contains neither emetine nor cephaeline (Chopra).

Tamil: Nattativadayam—; *Telugu*: Nattativasa—.

EPIPREMNUM.

The genus consists of 14 Malayan and Polynesian species.

Leaves very large entire	1. *E. giganteum.*
Leaves deeply cut into acuminate lobes	2. *E. mirabile.*

1. **Epipremnum giganteum** Schott is common on rocks and trees in the Malay Peninsula, whence it spreads over to Siam and Cochin-China.

The powdered spadices are used to mix with the dart poison by some of the Sakai tribes.

Malay: Rengut, Ringhut, Ringut—.

2. **Epipremnum mirabile** Schott is found in Martaban, Tenasserim, China, the whole of Malaya, Australia and Polynesia.

The plant is said to have anthelmintic properties.

HOMALOMENA.

The genus includes 30 Indo-Malayan and tropical American species.

A. Spathes red ... ... 3. *H. rubescens.*
B. Spathes green.
  a. Spathe 3 in. oblong, acute at base and top. Basal lobes of leaves divaricate ... ... 1. *H. aromatica.*
  b. Spathe 1-1¼ in. linear-oblong. Base of leaves rounded ... ... 2. *H. ovata.*

1. **Homalomena aromatica** Schott is found in Assam and Chittagong.

The large rhizome, which is invested with the old withered leaf-scales, bears numerous white long rootlets issuing from its surface, and is said to be held in high estimation by the natives as an aromatic stimulant.

Bengal: Kuchugundubi—.

2. **Homalomena ovata** Hook. fil. is found in Bukit, Timah and Singapore, whence it extends to Borneo.

The plant is used medicinally by the Malays.

Malay: Asam tikus, Kelamoyiang, Kumayan, Kumayan Jantan—.

3. **Homalomena rubescens** Kunth. is found in the Sikkim Himalaya, the Khasia Hills and Chittagong, extending to Java.

The plant is used as a poison by the Malays. It enters into the composition of 'ipoh' and is thrown into rivers to poison the water.

LAGENANDRA.

The genus consists of 5 species, spread over India and Ceylon.

Lagenandra ovata (Linn.) Thwaites (=*L. toxicaria* Dalz.) is a marsh plant occurring from the Konkan to North Kanara, Mysore, Coorg, Cochin, Travancore, and Ceylon where it is common in the Central Provinces.

The plant is said to have insecticidal properties. It is considered very poisonous in Southern India.

Southern Konkan: Vatsanabh—.

LASIA.

The genus consists of 3 Indo-Malayan species.

Lasia aculeata Lour. (=*L. heterophylla* Schott) is a stout spinous marsh plant occurring from tropical Sikkim Himalaya, Assam, Bengal and Burma, southwards to Ceylon and the Malay Peninsula, and extending to the Malay Islands and China.

The root is highly esteemed by the Santals as a remedy for affections of the throat (Campbell).

Among the Mundas the petioles, ground and mixed with water, are given to drink to cattle affected with throat disease.

The leaves and roots are a common remedy for piles in Ceylon.

Bengal: Kantakachu—; *Burma*: Zayap—; *Malay*: Bekil, Gli-gli—; *Mundari*: Janumsaru—; *Santal*: Rantasaru—; *Sinhalese*: Kohilla, Mahakshilla—; *Telugu*: Kantakachoramu, Mulasari—.

PISTIA.

The only species of this genus, **Pistia stratiotes** Linn., is a stemless stoloniferous floating herb found in still sweet water throughout India and Ceylon. It occurs in the tropics and subtropics, with the exception of Polynesia and Macronesia. In the Malay Peninsula it is commonly cultivated by the Chinese to feed pigs on.

The Ayurvedists consider the plant to be cooling and laxative; useful in diseases of the blood and tuberculous glands.

The Yunanists describe the root as bitter, diuretic, good for wounds, inflammations and burns.

The plant is cooling and demulcent, and is given in dysuria. It is said to destroy bugs most effectively.

The root is laxative and emollient.

The leaves are made into poultices and applied to haemorrhoids. Mixed with rice and cocoanut milk they are given in dysentery, and with rose-water and sugar in cough and asthma.

The ashes are applied to ringworm of the scalp.

The Mundas use the juice of the plant medicinally in ear complaints.

The whole plant has long been employed in ancient Chinese prescriptions. It is applied to boils, syphilitic eruptions and in many skin complaints.

A decoction of the leaves is used in La Reunion as a diuretic and prescribed in diseases of the urinary tract. Made into pills the leaves are used in syphilis.

The natives of the Gambia use the plant as an anodyne eyewash: the leaves are soaked in cold water. If the plant comes in contact with the body it produces a sharp stinging sensation, like a nettle sting, and the pain continues for some minutes.

An oil was prepared by boiling the juice of the leaves in cocoanut oil and used externally in chronic skin diseases. Relief was obtained in a number of cases (Koman).

Arabic: Satar-al-tayutas—; *Ashanti*: Ntanoa, Todia—; *Awuna*: Aflo—; *Bengal*: Pana, Takapana—; *Bombay*: Gondala, Prishni—; *Cagayan*: Aluluan—; *Canarese*: Antaragange—; *Chinese*: Fou Ping—; *Deccan*: Anterghunga—; *Egypt*: Hay-adem-el-ma—; *English*: Water Lettuce, Water Soldier—; *Ewe*: Aflo—; *Fanti*: Ntangtangaba—; *Ga*: Taitraimantai—; *Gambia*: Eyepity—; *Gujerati*: Jalakumbhi—; *Hausa*: Kainuwa—; *Hindi*: Jalkhumbi, Takapana, Unterungha—; *Hova*: Tsinkafonkafona—; *Ilocano*: Loloan—; *La Reunion*: Pensée d'eau, Pourpier de Madagascar—; *Madagascar*: Azafo, Hazafo—; *Malaya*: Fow phing, Kambiang, Kiambang—; *Malayalam*: Koddapail—; *Marathi*: Gondala, Jalamandri, Prasni—; *Mundari*: Jhalkumbhi—; *Sadani*: Jhalkumbhi—; *Sanskrit*: Akashamuli, Ashakumbhi, Daladhaka, Jalavalkala, Khali, Khamulika, Kumbhika, Kumuda, Kutrina, Paniyaprishthaja, Parni, Prashni, Shvetaparma, Untareitamara, Varimuli, Variparni—; *Sinhalese*: Atiudayan, Dayaparandella—; *Tagalog*: Quiapo—; *Tamil*: Agasatamarai—; *Telugu*: Akasatamara, Antaratamara, Koddapail, Nirubudiki—; *Tongking*: Beo cai—; *Twi*: Ntaya—; *Urdu*: Jalakumbhi—; *Uriya*: Baujhanjhe—; *Uruguay*: Lechuguita de agua, Ropollito de agua—; *Visayan*: Cayapo, Louanlouan

PLESMONIUM.

The genus is represented by **P. margaritiferum** Schott, a tuberous herb flowering before leafing and found in Bengal.

The country-people in Goa use the crushed seed to cure toothache; a small quantity is placed in the hollow tooth and covered with cotton; it rapidly benumbs the nerve; they also use it as an external application to bruises on account of its benumbing effect.

Among the Mundas the raw tuber, well ground, is rubbed on swellings of the extremities. The tubers are eaten. If they are not boiled in several successive kettlefuls of water, or together with tamarind leaves or tamarind pulp, they keep a noxious acidity which affects the throat and mouth with unbearable itching. It is said that the itching has sometimes proved fatal. Acid drinks are a counterpoison. The tamarind added ought, therefore, not to be spared.

Biru: Bonggajorena—; *Goa*: Azomut, Uzomut—; *Hasada*: Birhada, Hada—; *Naguri*: Hada, Tonanghada—; *Oudh*: Kharhar—.

POTHOS.

The genus includes 60 species, inhabitants of tropical Asia, Australia, Polynesia and Madagascar.

Bracts large concave thickly coriaceous	1. *P. cathcartii.*
Bracts very small	2. *P. scandens.*

1. **Pothos cathcartii** Schott occurs in the tropical Himalaya from Kumaon to Bhutan, Assam, the Khasia Hills, Manipur and Burma.

In Lakhimpur the leaves, fried in ghee, are eaten to cure various pains.

Lakhimpur: Hathidenkiya—.

2. **Pothos scandens** Linn. is found throughout India, on walls and tree trunks, from Bengal eastwards to Burma, and southwards to Singapore, and from the Konkan to Ceylon, the Andamans and the Nicobar Islands, extending to the Malay Islands and China.

The bruised stem and leaves are mixed with ox-urine and applied to the wounds in snake-bite; and an aqueous extract of the fresh stem and leaves is given internally (Roberts).

The stem and leaves have no effect in the treatment of snake-bite, whether taken internally or applied externally (Mhaskar and Caius).

Badaga: Arkaburu—; *Canarese*: Adikabiluballi—; *Malayalam*: Anapparuva—; *Siamese*: T'kep—; *Sinhalese*: Potawel—.

var. **cognatus** Engler, known in Malaya as 'Juloh-juloh', is used medicinally by the Malays. The powdered leaves are applied to the body to cure small-pox; the stem, cut up with camphor, is smoked like tobacco for asthma.

REMUSATIA.

The genus consists of 2 species, inhabiting tropical Asia and Africa.

Remusatia vivipara Schott is found in the subtropical Himalaya from Kumaon to Sikkim, the Khasia Hills and Burma, Chota Nagpur, the Western Ghats, Mysore and Ceylon. It extends to Cochin-China, Java and tropical Africa.

The root is made into an ointment with turmeric and used as a remedy for itch; and the juice with cow's urine is considered to be alexipharmic (Rheede).

Marathi: Rukhalu—; *Matheran*: Rokhalu—.

Rhaphidophora.

The genus includes 60 Indo-Malayan species.

Rhaphidophora pertusa Schott (=*Scindapsus pertusus* Schott) is a tall climber found in the Deccan Peninsula, the Coromandel Coast, Malabar, Ceylon and the Malay Islands.

The juice of the plant with black pepper is given to people who are bitten by the Russell's Viper. The juice, with that of the roots of *Croton oblongifolium*, and of the fruit of *Momordica charantia* is also applied to the bitten part.

This treatment is ineffective (Mhaskar and Caius).

Jolo: Mamao—; *Malayalam*: Anachukiri, Ilattimaravala—; *Marathi*: Ganeshkanda—; *Tagalog*: Pacpaclauin—; *Tamil*: Ilattimaravalai—; *Telugu*: Enuganalleru—; *Visayan*: Dayia—.

Sauromatum.

The genus consists of 4 palaeotropical species.

Sauromatum guttatum Schott occurs in the Punjab, the Gangetic Plain, the Western Himalaya, Chota Nagpur, the Bombay Presidency and Burma; extending to Sumatra.

The tubers are used as a stimulating poultice.

Bombay: Loth—; *Central Provinces*: Bhasamkand—.

Scindapsus.

The genus consists of 20 Indo-Malayan species.

Spathe green without yellow within, 4-6 in. oblong subcylindrical beaked. Spadix greenish-yellow ...	2. *S. officinalis*.
Spathe white or pale yellow, 2-2½ in. boat-shaped acuminate narrow long-beaked. Spadix white ...	1. *S. hederacea*.

1. **Scindapsus hederacea** Schott is found throughout the Malay Peninsula, climbing on rocks and trees in the low country.

A decoction of the stem is used by the Malays for rheumatism.

Malay: Akar lubang alah, Akar ular—.

2. **Scindapsus officinalis** Schott occurs in the tropical Himalaya from Sikkim eastwards, Bengal, Chittagong, Burma and the Andamans.

The ripe fruit is described in the Nighantas as pungent, sharp, heating, anthelmintic, aphrodisiac, galactagogue; sharpening hearing and appetite; regulating the bowels; useful in dysentery, asthma and troubles of the throat, Mahommedan writers speak of the fruit as aphrodisiac, cardiotonic; useful in ozoena and bronchitis.

The dried fruit is commonly used as a stimulant, diaphoretic, and anthelmintic.

Among the Santals the fruit is applied externally for rheumatism.

A decoction of the sliced fruit was tried in cases of asthma and found to act as an expectorant; it did not diminish the severity of the fit (Koman).

Bengal: Gajapipal, Gajapipul—; *Canarese*: Doddahippali, Gajahippali—; *Deccan*: Hattipipli—; *Dehra Dun*: Poriabel—; *Gujerati*: Mottopiper—; *Hindi*: Braipipli, Gaja pipal, Gajapipli, Maidah, Pippaljhhanca—; *Malayalam*: Anattippali, Attittippali—; *Marathi*: Thorapimpli—; *North-West Provinces*: Gajpippali, Hath, Ungliya—; *Sanskrit*: Chavyaphala, Chhidravaidehi, Dirghagranthi, Gajakrishna, Gajapippali, Gajavha, Ibhakana, Iboshana, Kapivalli, Karipippali, Kolavalli, Kunjarapippali, Shreyasi, Tejasi, Vartuli, Vashira—; *Santali*: Darejhapak, Dharejhapak—; *Tamil*: Anaittippili—; *Telugu*: Ennugatippali, Gajapippali—; *Urdu*: Gajapippali—; *Uriya*: Girudhuni, Gojopippoli, Odisimo—.

SYNANTHERIAS.

The genus is limited to 1 species, **S. sylvatica** Schott, found in the Deccan Peninsula, from the Northern Circars to the Konkan, and Ceylon.

The plant is pungent, anthelmintic, heating; improves taste; useful in tumours, pains, piles; causes biliousness.

The country people use the crushed seed to cure toothache. A small quantity is placed in the hollow tooth and covered with cotton; it rapidly benumbs the nerve; they also use it as an external application to bruises on account of its benumbing effect. In the Konkan, the seeds rubbed into a paste with water are applied repeatedly to remove glandular enlargements. The taste of the fruit is intensely acrid; after a few seconds it causes a most painful burning of the tongue and lips, which lasts, for a long time, causing much salivation and subsequent numbness.

Goa: Uzomut—; *Marathi*: Wajramuta—; *Sanskrit*: Aranyasurana, Chitrakandaka, Shvetasurana, Sitasurana, Surendra, Vanja, Vanakanda, Vanaolla, Vanya—.

TYPHONIUM.

The genus includes 25 Indo-Malayan species.

Typhonium trilobatum (Linn.) Schott is found in the Eastern and Western Peninsula and Ceylon, in Bengal, Assam, Chittagong, Burma, the Malay Peninsula. It extends to Siam, Cambodia, Tongking, Borneo and Java.

The roots are exceedingly acrid, and used in poultices; and also applied externally to the bite of venomous snakes, at the same time given inwardly about the size of a field bean. It is certainly a most powerful stimulant.

The acrid principle is very volatile; and by the application of heat, or by simple drying, the root becomes innocuous or even a wholesome article of diet. As an article of food, it relaxes the bowels and thereby relieves haemorrhoids.

The tubers eaten with bananas cure stomach complaints.

Mhaskar and Caius have shown experimentally that the root is not an antidote to snake venom.

Bengal: Ghetkochu—; *Hasada*: Cakad, Nirbisi, Niribisi—; *Malayalam*: Chena—; *Naguri*: Najompicki—; *Sinhalese*: Panuala—; *Tamil*: Karkarunaikkilhangu, Karunaikkilhanga—; *Telugu*: Duradakandagadda, Kandagadde—.

OBSERVATIONS OF SOME PECULIAR HABITS OF THE SPIDER (*MARPISSA MELANOGNATHUS*).

BY

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(*With two plates*).

In June, 1934, while passing along the compound of the Science College, Ballygunge, I noticed a thick column of minute biting ants, *Solenopsis geminata*, on the fencing of the compound. The column was unusually long and thick and the workers were very busy carrying minute particles of food-stuffs and eggs from an old stump of a tree to a new place of shelter at a distance of about thirty yards. While observing their activities my attention was drawn to a young spider, *Marpissa melanognathus*,[1] which was rushing and pausing at a little distance along a line parallel to that of the ants. From the movements of the spider I surmised that it wanted to cross the line of ants, but dared not do so. Curiously enough, a few minutes later, the spider instead of passing across, as I thought it wanted to do, fell upon the swarm of ants, carrying the food-stuffs and eggs, and ran away to a safe distance after snatching a morsel from one of them. Great consternation arose in that peaceful column, resulting in a disturbance in the regular line of march; the ants scattering in all directions. The ants, unable to move as fast as the spider, tried to follow the raider in vain. Irregularity in movements due to this disturbance spread over the entire column, but this was for a few seconds only. Soon the disturbance subsided, and it seemed that the pace of the carrier-ants was much more accelerated than before. In the meantime the spider having devoured the stolen food came back to its former position and waited intently for a fresh attempt. I thought it to be a stray case of snatching ants' food by a wandering spider, who happened to come across the ant caravan. But a few minutes later, when I moved to a different part of the line, two other younger spiders of the same species attracted my attention. They too lay in ambush by the side of the column evidently with the same purpose of raiding the ants. For two hours and a half I watched the activities of these spiders who successfully managed to snatch eggs or food from the ants several times. In one or two cases only their objective was missed, but the ants were so frightened that they dropped the eggs or food-stuff. After this, on several other occasions I observed similar raids on these ants by *M. melanognathus*. From which I am inclined to conclude that the young of this spider, until it matures, subsists largely on food or eggs taken from the

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[1] J. H. Comstock, *The Spider Book*, p. 678, New York, 1920.

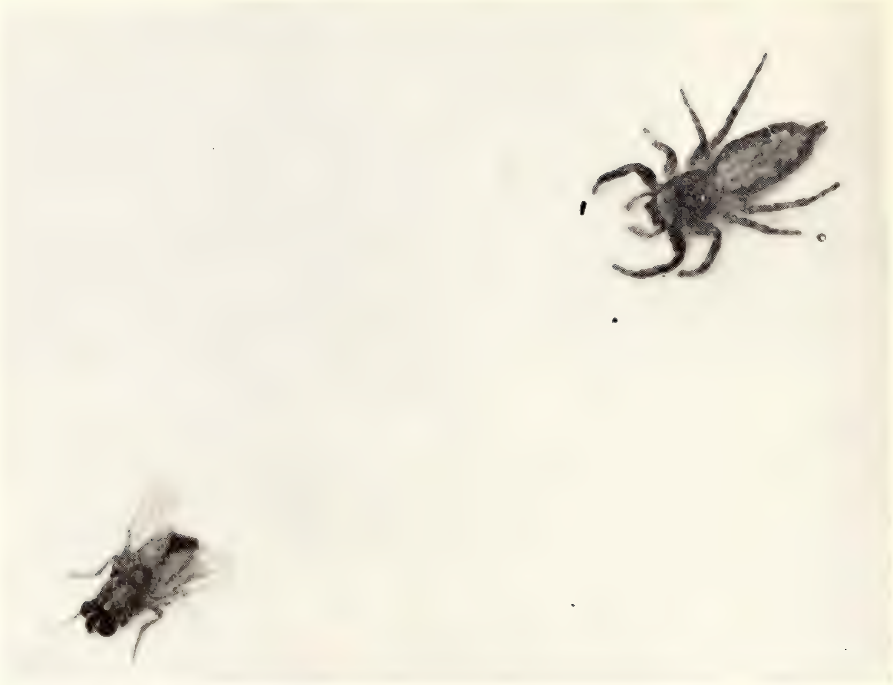

Fig. 1.—The spider (*M. melanognathus* ♀) stealthily approaching a sitting fly from behind.

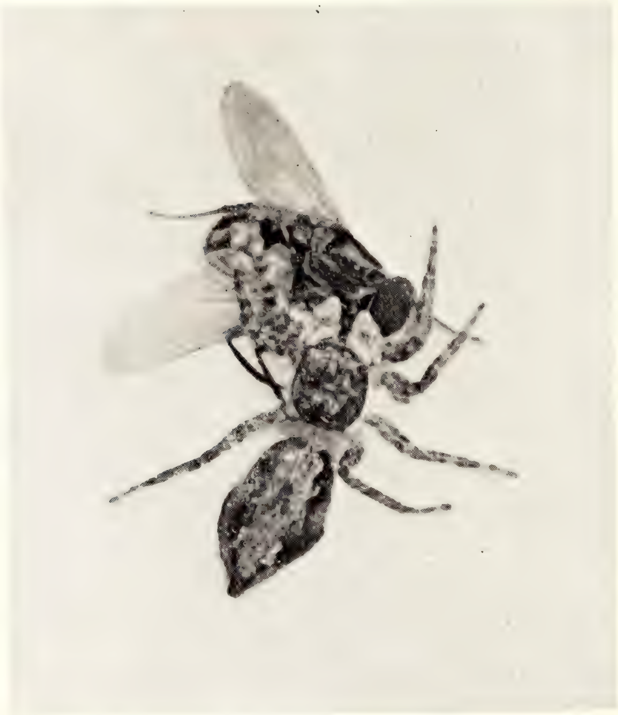

Fig. 2.—*M. melanognathus* ♀ seizing the fly.

ants, *Solenopsis geminata*, where they are abundantly distributed (Fig. 1).

M. melanognathus is a common spider found almost everywhere in Bengal. During the summer months they are seen loitering on the walls and floors of houses in search of prey. They spin no web, save for a shelter at the time of laying eggs. It is a white canopy built in a corner or a crevice of the house-walls, of oval shape and made up of three separate layers. Eggs are laid under the first layer and upon it the mother spider spends most of her time. Above this layer, there are two separate covers built one above another, while two doors, one opposite the other, are kept for coming in and goint out. Sometimes, before laying eggs, the female entertains the male on the upper layer of her retreat. Unlike most of other spiders, the female goes out hunting and carries her victims to a secluded place to feed undisturbed upon them. After reaching the adult stage they prey upon the common house-fly (*Musca domestica*). Their mode of capturing flies is marvellously skilful. The spider stalks the fly from a distance of about two feet or more. A fly is sitting on the floor, the spider advances towards it slowly, when close, it moves with still greater caution (Fig. 1). It approaches still closer; if it finds the fly facing it, the spider changes its course and moving backwards in a wide circle approaches the fly from behind. It then crawls towards the prey and, when in easy reach, jumps upon it (Fig. 2). Its spring is very accurate, it seldom misses its first attempt. In rare instances, a flank attack is made. A sitting fly usually appears to be too engrossed in its toilet to realise the imminent danger of an approaching spider even at close quarters. There might be an additional explanation of this apparent carelessness on the part of the fly, viz., that it cannot see things clearly from the distance at which the sharper-sighted spider can see without much difficulty. Moreover, the spider, though not a mimicking one, looks more or less like a fly when it stealthily crawls towards the victim.

These spiders are of quarrelsome habit. A chance meeting of two, if they happen to be of the same sex, results in the stronger one invariably attacking the weaker. If both the parties happen to be of equal strength they approach each other, raising their fore-legs upwards and rush headlong in a contest. The following incident will show clearly how aggressive these spiders are.

An adult spider *M. melanognathus* dropped on to a table from above, and remaining motionless for a while, jumped upon the polished stand of an apparatus at which I was working. The reflection of its own image in the polished surface of the stand attracted its attention. With raised body and lowered cephalothorax it looked intently at its image, which it took for another spider. It moved up and down the stand to seize its imaginary opponent. Being disappointed, it became angry and raising its fore-legs, dashed furiously at the stand. Unable to seize its supposed opponent, it stopped a while to recover from the shock. It followed its reflection round the stand and dashed as ineffectively against it. Failure after failure made the spider so furious that it dashed repeatedly against the surface, at times springing at its reflection from a little distance. The same operation, with short intervals of rest, was repeated for more than ten minutes. The spider now exhausted, gave up the attempt and walked away from the spot.

The courting of these spiders, previous to mating, may be of interest. The amorous gestures performed by the male before mating are not as elaborate as those of the *Lycosid* spiders. The male advances towards the female with his fore-legs raised and keeping at a respectable distance moves forwards and backwards (Fig. 3). This continues for a long time. He now comes closer and caresses her with his raised fore-legs (Fig. 4). The female treats these demonstrations with unconcern. She moves here and there as though busy in search of prey and not interested in the matter. During this procedure, when opportunity offers, the male gets upon her back and turning the abdomen inserts the intromittent organ into the orifice several times at intervals. The female never attacks the male after mating as is wont with some species of *Lycosid* spiders.[1] *

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[1] G. Bhattacharya, *Transactions of the Bose Research Institute*, vol. vii, p. 248 (1931-2).

* A superstition about this particular spider is prevalent among the Hindus of Eastern Bengal that the spider carrying a fly in its jaws is considered as an indispensable sign of good luck by the bride's party on the occasion of marriage ceremony and these spiders are therefore carefully collected alive for the purpose. Similar superstitious beliefs are not rare or unknown even in Western countries. (Vide *Notes and Queries*, vol. ii, p. 165; ibid., vol. iv, 2nd. ed., pp. 198 and 377; and *Am. Spid. and their Spin. Work*, vol. iii, pp. 81-3.)

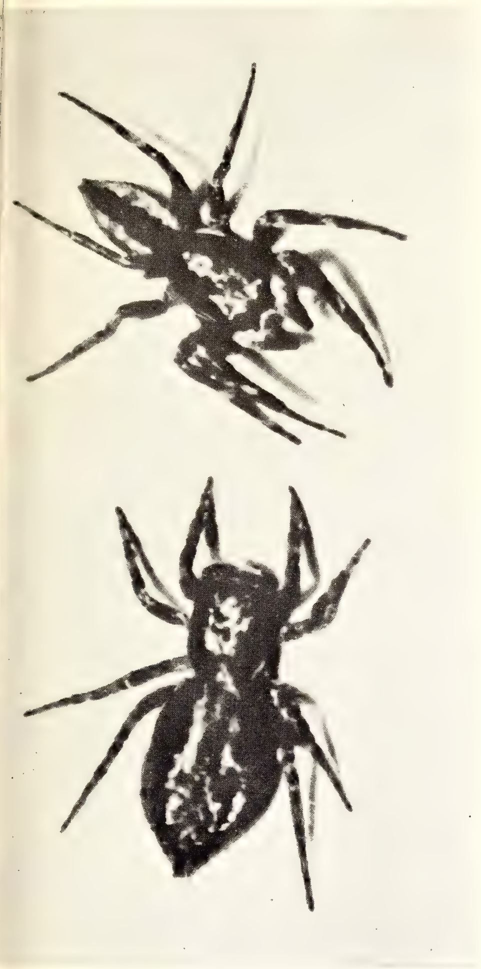

Fig. 3.—The male spider courting the female prior to mating.

Above—*M. melanognathus* ♂.

Below—*M. melanognathus* ♀.

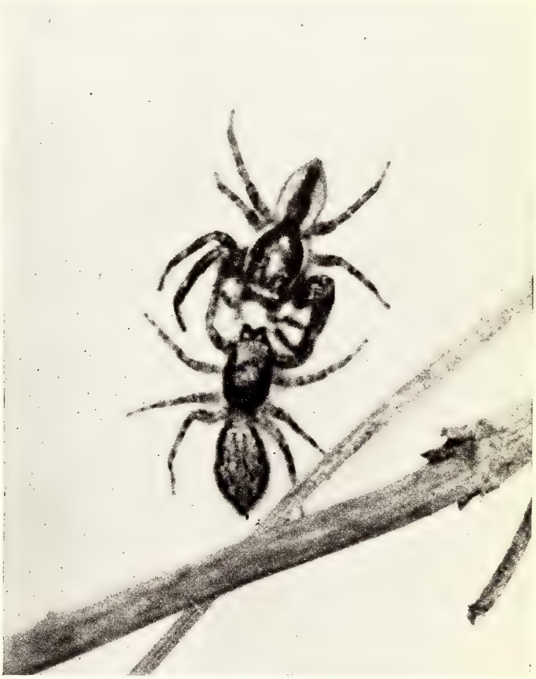

Fig. 4.—The male (above) is caressing the female (below) with raised forelegs.

Courting attitudes of the spider (*Marpissa melanognathus*).

AN UNDESCRIBED TINGITID FROM SOUTH INDIA.

BY

CARL J. DRAKE.

(*Ames, Iowa, U.S.A.*).

The present paper is based upon a small collection of lace bugs from South India kindly sent to the writer by Mr. M. C. Cherian for identification. One species, *Monanthia cheriani* Drake, is described below as new to science.

Monanthia cheriani Drake, sp. nov.

Small, body black, the reticulations whitish testaceous. Antennae slender, whitish; segment I short, a little longer and slightly stouter than II; III very slender, three times as long as IV; IV slightly enlarged, the distal two-thirds dark brown. Head moderately convex above, black, armed with five slender whitish spines; anterior pair short, very slender, resting on the surface of the head; posterior pair and median spines long, directed forward, contiguous with the surface of the head; extending almost to the anterior margin of the eyes. Rostrum testaceous, darkened at tip, not quite reaching the intermediate coxae. Legs slender, testaceous, the tarsi darker.

Collum raised, reticulate, faintly produced anteriorly. Paranota broad, testaceous, turned back upon the dorsal surface of the pronotum, the outer margin broadly rounded and almost touching the median carina. Carinae testaceous; median carinae slightly more raised behind, there with long, low areolae; lateral carinae short, confined to posterior triangular portion of pronotum, faintly divaricating. Pronotum black, the reticulation of posterior portion testaceous. Elytra broadest near middle, faintly constricted a little beyond the middle, considerably longer than abdomen; costal area rather narrow, uniseriate, testaceous, mostly biseriate, triseriate in widest part, the areolae rather large; discoidal area almost reaching middle of elytra, rather widely reticulate, with five areolae in widest part, narrowed towards base, widest near apex, there with the outer margin bowed outwardly and with a distinctly raised, brownish black point on the boundary, the inner margin distinctly curved; areolae hyaline, the nervelets of discoidal and basal portion of sutural areas blackish.

Length, 2.12 mm.; width, .90 mm.

Holotype (male) and *allotype* (female), Coimbatore, India, on *Corida* sp., March 1, 1920, collected by Dr. T. V. Ramakrishna Ayyar, in Drake collection. Paratypes, 4 specimens, taken with type, in collections of M. C. Cherian and author.

Hormisdas vicarius Drake.

Travancore, South India, 5 examples, taken on *Urena lobata* L., by Mr. M. C. Cherian. Heretofore known only from the Philippines.

NOTES ON COCCIDÆ (*HOMOPTERA RHYNCHOTA*) FROM SOUTH INDIA.[1]

BY

RAO SAHIB DR. T. V. RAMAKRISHNA AYYAR, B.A., Ph.D.,

Late Government Entomologist, Agricultural Research Institute, Coimbatore.

INTRODUCTION.

Fresh data on the South Indian Coccidæ collected since the publication of my previous papers[2] on these insects, are recorded in this paper. The material reported here comprises twenty-nine species distributed over seventeen genera. Six of these species are new to science and are being described by Green elsewhere. Seven well known species are being recorded for the first time from South India.

I am greatly indebted to Prof. E. E. Green, the well known authority on these insects, for his kind help and valuable suggestions.

SYSTEMATIC ACCOUNT.

Sub-family: DIASPINÆ.

Leucaspis riccæ Targ.

This well known species is now recorded for the first time from South India. Numerous specimens were taken on an unknown plant at Hyderabad, Deccan.

Pinnaspis marchali Cockl.

This species was originally described from West Africa, where it attacks the Oil palm. It is very common on Western Ghats in South India. Numerous specimens were taken on the spikes of *Piper nigrum* along with another species *P. aspidistræ* Sign. at the Taliparamba pepper farm, Malabar.

Aspidiotus lataniæ Sign.

This species was previously recorded on *Ficus carica* from Ceylon, on *Phœnix* from Calcutta, on *Citrus* sp. from Bombay, on *Carissa* and sissal hemp from Coimbatore and apple stems from the Shevaroys. I recently collected this species on *Acacia dealbata* from the Nilgiris.

Aspidiotus tamarindi Green.

This common species is an important pest of *Tamarindus indica* Linn. I have recently bred the Chalcid parasite *Comperiella indica* Ramakr.[3] from this scale at Coimbatore.

Aspidiotus (Chrysomphalus) aurantii Mask.

This species was previously recorded on mulberry at Pusa and pomelo at Myitkyina. This is also reported as a serious pest of oranges in California and other important orange-growing countries. It is widely distributed in India and is known as an important pest of citrus plants. From South India the species was previously reported on guava, rose, morinda, jasmine, etc. I recently noted this species on oranges at Coimbatore and the Nilgiris. The species has not previously been reported on oranges from South India and it might prove an extremely dangerous pest.

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[1] This paper was read at the Twenty-third Session of the Indian Science Congress held at Indore in January 1936.

[2] Ramakrishna Ayyar, *Journ., Bombay Nat. Hist. Soc.*, xxvi, 621-8 (1919); *Rep. Proc. Fourth Ent. Meet. Pusa*, pp. 336-62 (1921); *Bull. Imp. Council Agric. Res. Inst., Pusa*, No. 197, pp. 76 (1930).

[3] Ramakrishna Ayyar, *Rec. Ind. Mus.*, xxxvi, p. 219 (1934).

Aspidiotus (Pseudaonidia) trilobitiformis Green.

Taken on guava at Coimbatore; this is the first record of this species on this plant.

Lepidosaphis beckii New.

This species was originally reported on pepper from Travancore and is now being recorded for the first time on citrus plants from the Nilgiris. This is an important pest of citrus plants.

Lepidosaphis hawaiiensis *var.* **indica** Green.

This variety was taken on the bark of *Albizzia* at Coimbatore.

Lepidosaphis cornutus, sp. nov. (Green Ms.).

Numerous specimens generally resembling *L. piperis* Green were taken on leaves and vines of the betel vine, *Piper betle*, at Tirukulum, North Arcot District. The specimens differ from those of *L. piperis* in the short tubercular spine on either side of the head and Green has determined them as belonging to a new species, which he is describing under the name *cornutus*.

Parlatoria proteus Curt.

This species was previously reported on *Cymbidium bicolor* from Ceylon and on *Vanda* and other Orchids from Bangalore. I recently noted numerous specimens on *Aerides bridleyanum* in the Nilgiris.

Parlatoria mangiferæ Marl.

Noted on *Commiphora berryi* at Coimbatore.

Paralatoria blanchardi Targ.

This is the first record of this species from India. Originally reported on date palm from West Africa, it is being recorded on the same plant from Hyderabad, Deccan.

Sub-family: LECANIINÆ.

Ceronema kœbeli Green.

This species was previously reported on *Sapium sebiferum* and *Pithecolobium* from Ceylon and is being recorded for the first time from South India. Numerous specimens were taken on *Cæsalpinia* sp. at Coimbatore.

Pulvinaria durantæ Tak. (?)

This species is closely related to *P. psidii* Green. Numerous specimens were taken on *Amaranthus* sp. at Coimbatore.

Pulvinaria maxima Green.

Since the publication of my previous paper[1] on this species the following parasites have been bred from specimens taken on Melia at Coimbatore: *Anicetus ceylonensis* (How.), *Encyrtus flavus* How. and *Perrisopterus* sp.

Pulvinaria psidii Green.

The following Chalcid parasites were recently bred by me from specimens of this species taken at Coimbatore: *Encyrtus kotinskyi* (Full.), *Adelencyrtus chionaspidis* (How.), *Aphelinus mytilaspidis* Le Baron and a species of *Coccophagus*.

Lecanium marsupiale Green.

This species was previously reported on pepper, *Pothos* and *Anona* from Ceylon. Numerous specimens attacking pepper were recently received from Coorg.

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[1] Ramakrishna Ayyar, *Mem. Dept. Agric. Ind., Ent. Ser.*, viii, p. 30 (1925).

Lecanium latioperculum Green.

This species was taken on *Anacardium occidentale* Linn. in Malabar.

Aclerda japonica *var.* **inermis** Green.

Numerous specimens of this species were taken on the leaf-sheath of sugar-cane at Anakapalle, Godavari District, along with *Pseudococcus* (*Trionymus*) *sacchari* Cockl.

Sub-family: ASTEROLECANIINÆ.

Cerococcus ramakrishnæ sp. nov. (Green Ms.).

This new species is related to *C. ovoides* Cockl., from which it is distinguished mainly by its larger size. Specimens of this species were taken on rootlets of *Ficus* sp. at Coimbatore.

Sub-family: DACTYLOPIINÆ.

Pseudococcus (Ferrisia) virgatus Cockl.

This species is common on *Dolichos lablab* at Coimbatore and Malabar.

Trionymus sacchari (Cockl.).

This well known species is a rather serious pest in almost all sugar-cane growing countries. It has also been noted on paddy from South India. Attacks of this species on the roots and leaf-sheaths of sugar-cane and sorghum recently came under my notice at Anakapalle. My remarks in my previous paper[1] on the *soorai* disease of the paddy plant do not really refer to this species, but to the following species.

Ripersia oryzæ Green.

This species is the cause of the common *Soorai* disease of the paddy plant in the Tanjore delta. It has recently been found in Malabar also. Besides the paddy plant, the species attacks numerous other species of grasses including the ragi, *Eleusine coracana*.

Pseudantonina rigida, sp. nov. (Green Ms.).

This species was taken on the grass *Iseilema laxum* Hack. at Samalkota, Godavari District.

Pseudantonina imperata, sp. nov. (Green Ms.).

On the grass *Imperata arundinacea* at Anakapalle.

Antonina zonata Green.

This is the first record of this species from India. Taken on bamboo at Coimbatore.

Icerya pilosa Green.

In 1896, this species was reported on the common shrub of the sand dunes, *Spinifex squarrosus* Linn. from the Coromandel Coast of the Madras Presidency. It has recently been reported on the same plant from the West Coast also.

Icerya purchasi Mask.

This serious exotic pest found its way into India somewhere about the years 1928 and 1929 and was first reported on wattles (*Acacia*) from the Nilgiris. I have recently noted the species on a few other plants, including citrus near about Coonoor, Nilgiris. The rapid multiplication of the species appears to have been somewhat checked by the introduced lady-bird, *Novius cardinalis*, which is predaceous on it. The species does not as yet appear to have found its way to the plains.

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[1] Ramakrishna Ayyar, *Bull. Imp. Council Agric. Res. Ind., Pusa*, No. 197 p. 59 (1930).

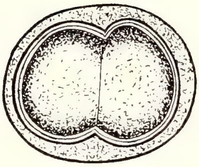


Fig. I.

50 μ

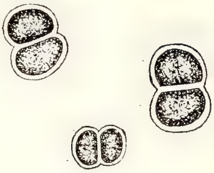


Fig. II.

50 μ

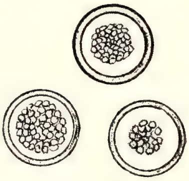
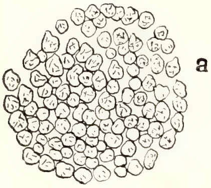


Fig. IV.

25 μ



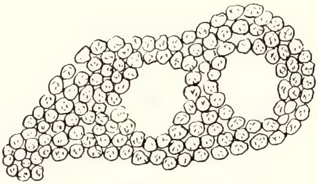


Fig. V.

25 μ

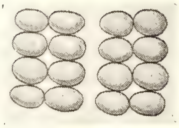


Fig. III.

25 μ

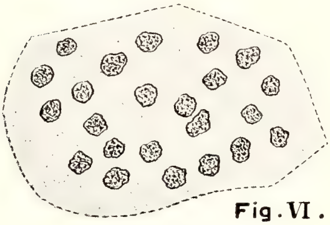


Fig. VI.

25 μ

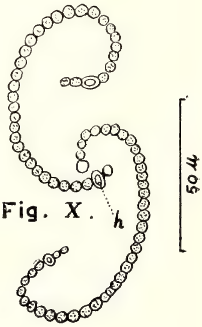


Fig. X.

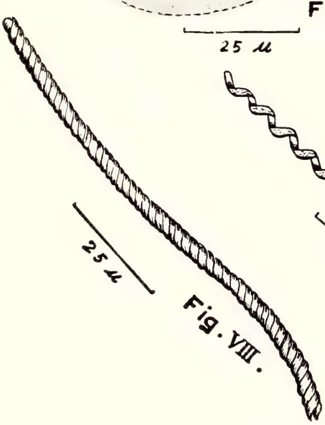


Fig. VIII.

25 μ

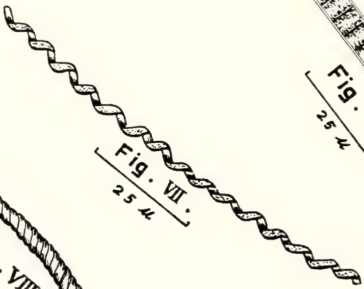


Fig. VII.

25 μ

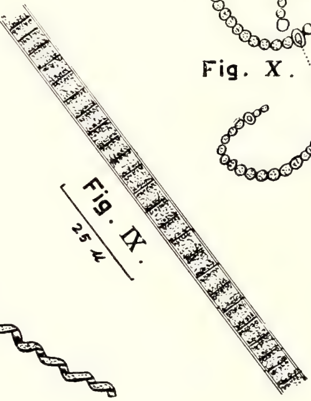


Fig. IX.

25 μ

ALGAL FLORA OF HYDERABAD, DECCAN.
(For explanation see text).

A PRELIMINARY SURVEY OF THE ALGAL FLORA OF HYDERABAD (DECCAN).

PART I. **Myxophyceæ**

BY

M. GHOUSUDDIN, M.SC. (Alig.)

(*With two plates*).

The study of the Algal Flora of Hyderabad State has been taken up recently. The State with its varying ecological conditions deserves an extensive investigation, and the results are sure to be of general interest. The scope for research on the Fresh-water Algae of the Nizam's Dominions is facilitated by the existence of more than 18,000 natural and artificial tanks, which are the chief supply for irrigation and drinking purposes throughout the State. In connection with my work on the 'Distribution of the Diatoms in the Nizam's Dominions', to be published elsewhere, material of other fresh-water algae was also collected and preserved during the last two years and is now to be described briefly. For the present I consider the commonly distributed forms, which are met with and reported from other parts of India also; but as this is the first record from the Dominions, it may be of some interest. Owing to lack of full literature only common types have been dealt with, but an extensive study of the material collected is in progress and will be published in due course.

UNICELLULAR AND COLONIAL FORMS.

Cells or colonies free floating or forming a gelatinous stratum. Reproduction by simple cell division. . . Family: CHROOCCOCCEAE.

Cells globose with firm, thick membrane, solitary and free floating (Fig. i, pl. I). *Chroococcus giganteus* West.

Cells solitary, free floating with colourless sheaths (Fig. 2, pl. I). *C. turgidus* (Kutz) Nag.

Collections from Husain Sagar and Mir Alam tanks show a fair number of both the species.

Cells spherical, adhering in groups of four and arranged in rows to form flat rectangular colonies. Abundant (Fig. 3, pl. I). *Merismopedia elegans* A. Braum.

Colony spherical, sheaths colourless, indistinctly lamellose cells spherical or angular by mutual pressure, blue-green—from Husain Sagar (Fig. 4, pl. I). *Gloeocapsa aeruginosa* (Carmich) Kutz.

Colonies at first spherical, later irregular in shape. Cells spherical, numerous, blue-green or brown. Common (Fig. 5, pl. I). *Clathracystis aeruginosa* (Kutz) Henfery.

Cells embedded in a gelatinous matrix to form spherical colonies. Cells globose, contents granular, blue-green (Fig. 6, pl. I). *Aphanocapsa grevillei* (Hass) Rabenhorst.

FILAMENTOUS FORMS.

(A) The trichomes consist of a single uniform row of cells, not branched, heterocysts absent. Enclosed in more or less gelatinous sheaths of variable size. Family: OSCILLATORIACEAE.

Trichomes not more than one in a sheath, filaments unbranched. Sub-family: LYNGBYEAE.

Trichome narrow, twisted into a regular spiral, the coils apart (Fig. 7, pl. I). *Spirulina major* Kutz. Trichomes relatively wide, coils closely arranged (Fig. 8, pl. I). *S. turfosa* Cram, Trichomes of both the species are often observed in the collections mixed with other forms, but almost pure material of *S. turfosa* with a fair proportion of *S. major* was found in a little pool near Isolation Hospital, University Road.

Trichomes free or interwoven to form a thin substratum, cells cylindrical, without conspicuous sheaths, with oscillating movements. OSCILLATORIA Vaucher.

(1) Filaments long, straight with obtusely rounded apex, slightly constricted at the joints, cell contents granular olive green or brown (Fig. 1, pl. II). *Oscillatoria limosa* Ag.

(2) Filament long, straight or curved, cells about 1/6 in length then wide, apical cell slightly capitate, cell contents granular, dark green to bluish gray (Fig. 2, pl. II). *O. princeps* Vauch.

(3) Filament long, straight with rounded apex, constricted at the joints, cells less than ½ as long as broad, pale bluish-green, mixed with other filamentous algae (Fig. 3, pl. II). *O. tenuis* Ag.

Filaments not showing oscillating movements with conspicuous, firm sheaths, free floating or forming an expanded substratum. LYNGBYA C. Agradh.

(1) Filaments flexuous forming intricate masses, dark blue-green, sheath thin, hyaline, cells almost quadrate, not constricted, apical cell round not capitate. Common (Fig. 9, pl. I). *Lyngbya aerugineo-caerulea* Kutz.

(2) Filaments long, sheaths coated with iron-hydroxide, cells quadrate. *L. ochracea* Kutz.

Common in the River Moosi.

(B) Filaments simple, unbranched, heterocysts present, free floating or embedded in gelatinous masses, sheaths unconspicuous and confluent. Cells generally torulose in a single row. Family: NOSTOCACEAE.

Colonies spherical, later on irregular filaments irregularly interwoven and contorted. Cells globular or barrel shaped, with intercalary heterocysts. Colonies forming yellowish-brown gelatinous masses in the River Moosi and adjacent ponds (Fig. 10, pl. I). *Nostoc commune* Vaucher.

Filament single, free floating, wound in spirals, cells almost spherical, heterocysts a little larger than the vegetative cell. Stray filaments met with in a collection made from a small pond near Umdasagar (Fig. 6, pl. II). *Anabaena spiroides* Kelb.

Filament single, free, vegetative cells cylindrical, usually longer than the diameter, heterocyst terminal, spore oval, big, next to the heterocyst. Rare in the River Moosi and Mir Alam Tank (Fig. 7, pl. II). *Cylindrospermum stagnale* Born et Flah.

(C) Filaments in a firm sheath with intercalary heterocysts, filament with false branching. Family: SCYTONEMATACEAE.

Branches arising generally in pairs, cells about twice as long as broad, apical cell rounded, heterocysts intercalary, abundant on the banks of Mir Alam and Husain Sagar tank (Fig. 4, *a*, *b*, *c*, pl. II). *Scytonema mirabile* Thurst.

Branches arising as a rule singly, arising from the main filament beneath a heterocyst, heterocyst intercalary shorter than the vegetative cells (Fig. 5, pl. II). *Tolypothrix* sp.

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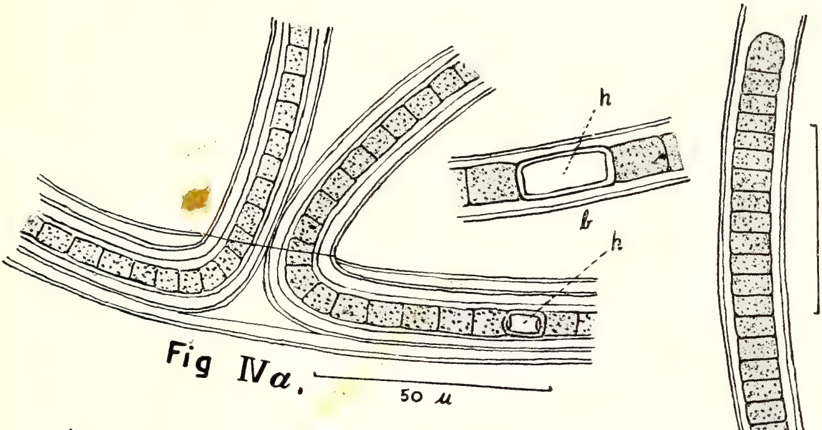
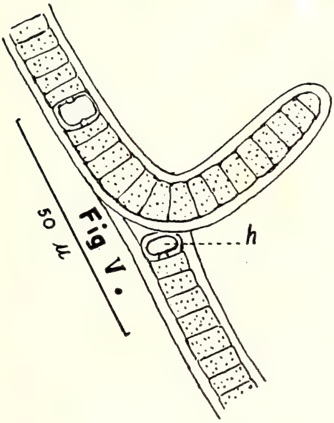
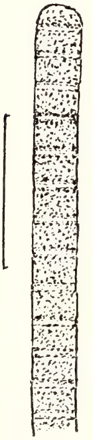
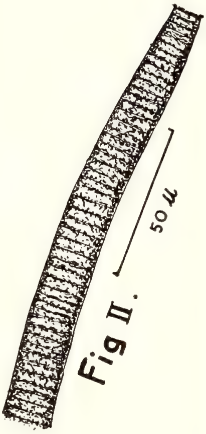
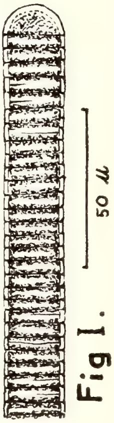
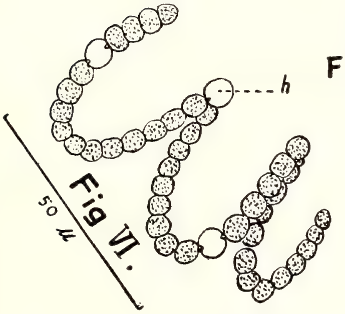

h
b
h
c 30 µ
Fig IVa.
50 µ











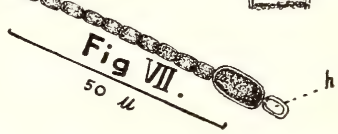


Fig VII.
50 µ
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Algal Flora of Hyderabad, Deccan.
(For explanation see text).

REVIEW.

INDIAN SCIENCE ABSTRACTS (Being an Annotated Bibliography of Science in India). Published by the National Institute of Sciences of India; July 1936; Calcutta. Price, Rs. 7-8.

'Originally the publication was intended to include abstracts of all scientific papers published in India, but at a later date the Council decided also to include abstracts of all papers published abroad on work done in India or based on Indian material.'

An ambitious programme, indeed; and one which for the present has only resulted in the production of a costly publication in which the sins of omission are many and the sins of commission not a few.

The intention, nevertheless, deserves praise; and the get-up is excellent.

J. F. C.

OBITUARY.

HERBERT MUSGRAVE PHIPSON.

(1850—1936).

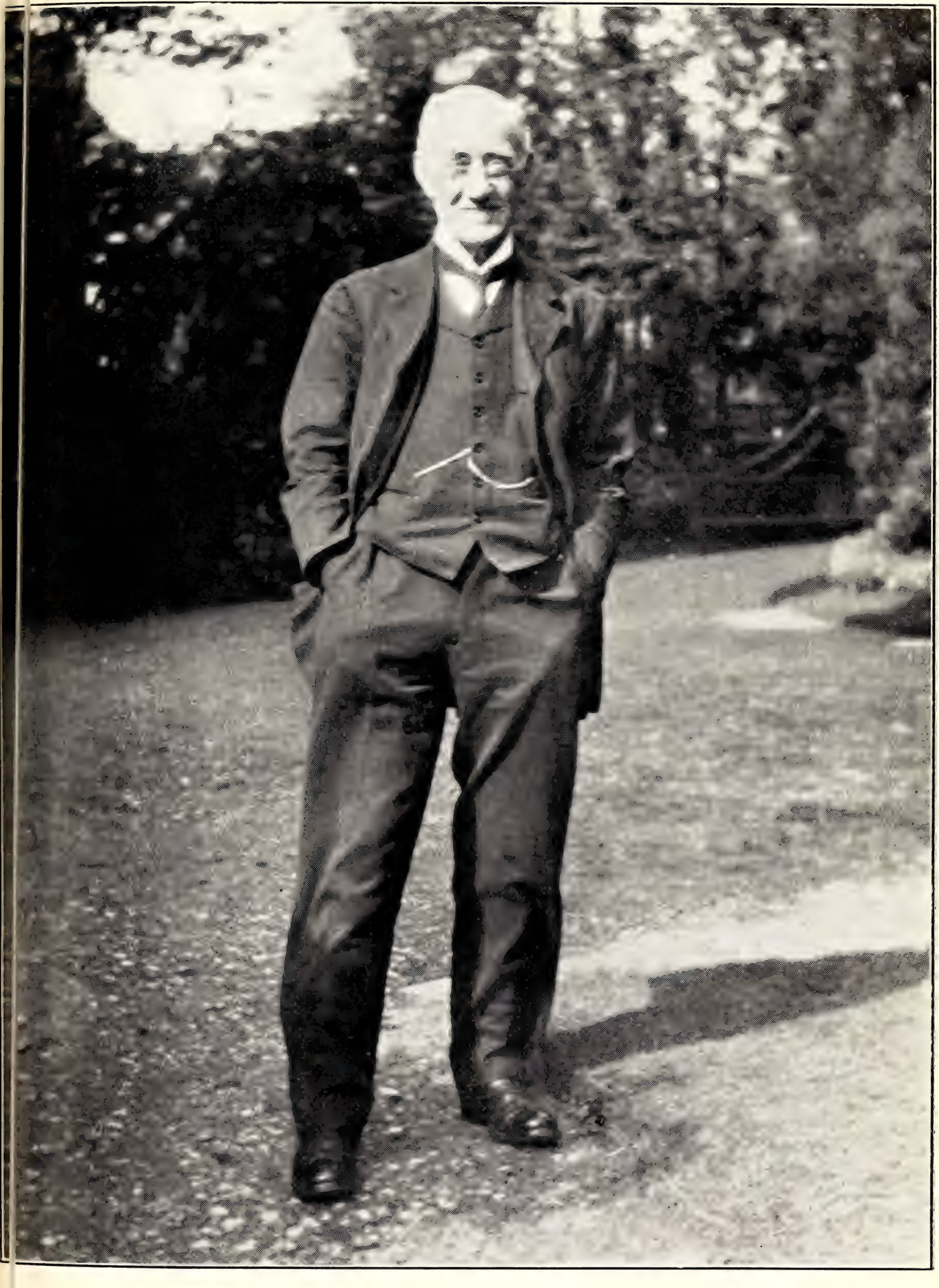
The son of Mr. T. W. Phipson, Q.C., of Lincoln's Inn, born 1850, educated at Clifton. Went out to India first in 1878 as a partner in J. A. Forbes & Co., East India Merchants. Established the firm of Phipson & Co., Wine Merchants, in 1883. Married Dr. Edith Pechey, M.D., head physician of the Cama Hospital for Women and Children in 1899. Left India in 1906. Died in London on Tuesday, 7th of August 1936, at the age of 86.

Few Europeans in the Western Presidency, unconnected with its government and administration, have a better claim to grateful memory than Mr. H. M. Phipson and he undoubtedly left this Presidency the richer for his association with it.

The Bombay Natural History Society to whose growth and development he so greatly contributed and the Pechey Phipson Sanitarium for Women and Children at Nasik remain as memorials to his life and work in India.

It is fitting that this *Journal* should firstly commemorate Mr. Phipson's work for the Society. He was in England when the eight original founders of the Society met at the Victoria and Albert Museum, Bombay, on the 15th September 1883. He joined the Society on his return from England in the same year, and in January 1884, offered a room in his offices at 18, Forbes Street, as a more central place for the Society's meetings and for keeping its collections. The removal of the Society's offices to a central situation in the city and Phipson's enthusiastic association with it gave an astonishing impulse to its growth. The need for finding better accommodation for its rapidly increasing collections soon becoming urgent, Phipson again provided the solution by offering the Society part of the larger premises he had acquired at 6, Apollo Street, to which the Society's collections were transferred in 1886 and where its offices still remain. Phipson's interest in Natural History and his zeal for the Society were contagious. He interested his numerous friends in the Society's work and imparted his devotion to the young men who came out to India to assist him in his business. His advice to the young European in India was 'develop a hobby' and to him there was no finer hobby than Natural History. Thus commenced and thus was continued the long association of the Society with the Company which bears Mr. Phipson's name. His successors in business took over his post of Honorary Secretary and Editor of the *Journal* and have each in their time made their contribution to the Society's progress.

From March 1886 when he took over the office of Honorary Secretary from E. H. Aitken, more familiarly known for his books



H. M. PHIPSON.

as 'EHA', to April 1906 when he left India, Phipson was the heart and soul of the Society. Originating and directing its early activities he brought it to vigorous maturity. Through these twenty years he edited the Society's *Journal*—for a year in collaboration with Robert Sterndale, then as sole editor for fifteen years and finally in collaboration with Mr. W. S. Millard his immediate successor in office.

His business and his management of the Society's affairs left Phipson little time for contributing in print the wide knowledge he had acquired of Indian Natural History. His favourite branch was Snakes. His rare contributions to the *Journal* centre round this subject, and among the notes he published is a paper on the Snakes of the Bombay Presidency.

Phipson directed his energies to increasing the influence and usefulness of the Society to Zoologists and laymen and to the building up of its collection. So intimately is his name associated with the work that even today the Society's rooms at 6, Apollo Street, are often referred to as 'Phipson's Museum'. In his day Phipson was its presiding genius. He welcomed visitors great and small and taking them round the collections would treat them to a wealth of interesting facts and anecdotes drawn from the wide fund of his knowledge and experience. He was charming: always interesting and ever ready with shrewd and amusing comment. In the early days of the Society various animals, birds and reptiles were kept alive in the Museum. Amongst these was a cobra with which Phipson was on familiar terms. He once turned this cobra out of its blanket and patted its coils to make it sit up and expand its hood before some visitors. The cobra, probably startled, turned and struck at Phipson and buried its fangs in one of his fingers. Phipson displayed his usual coolness in this dreadful situation. His remedy was drastic. He went to the Society's small laboratory adjoining the museum and applied some cyanide of potassium to the wound. Except for some swelling of the finger he fortunately escaped unharmed.

The numerous offers of live animals which the Society was receiving gave Phipson the idea of establishing a Zoological Garden in Bombay, conducted and managed by the Society. What at first seemed a promising venture failed because the Municipality were unwilling to allow the use of the site selected by Phipson for the purpose. In his ambition to provide Bombay with a really fine Natural History Museum, Phipson had succeeded. He early foresaw the necessity for finding suitable and adequate accommodation for the rapidly growing collections of the Society and realised the useful part the Society could play in the establishment of such a museum. An opportunity of accomplishing his objective presented itself when in 1904 he was elected to serve on a Committee appointed by Government to consider the question of a Public Museum and Library for Bombay. At the third meeting of this Committee, Phipson proposed that the Public Museum should take the form of three separate buildings, one for Art and Archaeology, the second for a Public Library and the third for a Natural Science Museum, Mr. Phipson's proposals find realisation today in the Prince of Wales' Museum, which is built on the site suggested by him and which now includes a main building for Art and Archaeology and a separate building for Natural History. It would have given Phipson much joy to read the report on Museums in India made at the Conference of the Museums Association held at Leeds this year in which the Natural History galleries of the Prince of Wales' Museum, where the Society's collections are now exhibited, are described as amongst the finest in the world. It is now proposed to name one of the splendid galleries of this museum after Phipson in memory of his association with the work of the Society. His name is also fittingly perpetuated by Zoologists, who named new discoveries after him. These include a new Sea Snake *Hydrophis phipsoni* (*Distira cyanocincta*) described by Murray (*J.B.N.H.S.*, vol. ii, p. 32) and a new earth snake *Silybura phipsoni* described by Mason, *A.M.N.H.* (6), i, 184. In his preface to the Volume on *Arachnida* in the *Fauna of British India Series*, Pocock, the author, acknowledges his indebtedness to Phipson whose influence and energy in obtaining a collection of over a 1,000 scorpions from all parts of India provided the basis for his study. Phipson's association with the work is perpetuated in the various Arachnids Pocock named after him. These include a new scorpion *Isometrus phipsoni* (Pocock, *J.B.N.H.S.*, vol. iii, p. 244), a new Whip scorpion *Phrynicus phipsoni* (Pocock, *Fauna of British India*, Arachnida, p. 127) and a new Galeod spider named *Rhagodes phipsoni* (Pocock, *J.B.N.H.S.*, vol. ix, p. 448). Though the Society's Mammal Survey of India, Burma and Ceylon was taken up long after Mr. Phipson's departure from India, Oldfield Thomas, who described many of the new species discovered by the Survey, named a beautiful Flying Squirrel in honour of Mr. Phipson 'to whose initiative and enthusiasm the Society owes so much of its prosperity and to whose ready help most Indian Zoologists have at various times been greatly indebted'. Few men have striven more earnestly, more continuously to advance a purely unselfish cause and few have laboured for the advancement of Science and for the general good in a more self-effacing and unobtrusive spirit. Phipson was always ready to help anyone, and, as one friend with whom he lived said:—'He monopolized the self-denial of the whole house!' This was the key to the character of the man and to his life of service. He was for many years the Honorary Secretary of the Bombay Branch of the Countess of Dufferin's Fund and in 1885 and 1887 organised two fancy fair fetes which added a substantial sum to the fund, when the late Lady Reay was the President of the Bombay Branch. Among other activities which will commemorate the name of Phipson and his wife is the Pechey Phipson Sanitarium for Women and Children at Nasik, Deccan. The institution was founded by them to enable poor women and children in Bombay to recuperate in the bracing air of the Deccan after illness and it now consists of twenty-one cottages, with a hostel for working girls. It is open to all communities.

MISCELLANEOUS NOTES.

I.—ASSOCIATION BETWEEN A LEOPARD AND A TIGRESS.

I had the good fortune of witnessing a very strange association between a large leopard and a full-grown tigress. An instance of animal companionship which is surely given to very few sportsmen to see.

I was invited by my maternal uncle, His Highness the Nawab Sahib of Tonk, to a tiger shoot in one of his very large detached territories in Central India known as Seronj. The Vindhya Range runs through the heart of this pargana, and the scene of occurrence lay in one of its very lovely reserved forests called Samalkheri. The story related by the shikaris was that in these forests there was a large leopard which always killed the bait, and that a tigress waited and took part in eating the kill. The story sounded improbable. To discover what truth there was in it I obtained permission from His Highness to try and bag both the tigress and her supposed mate the leopard.

On the night of the 25th of March, 1936, I sat up to watch. A young buffalo was tied out as a bait. The sun had hardly set when I heard the 'sawing' of the leopard and the long drawn moan of the tigress. It seemed as if both were in the same place. A little later a sambhur belled and langoors began to swear as the felines passed beneath them. All was again quiet, and not till the sun had set and it was fairly dark did I hear the bait jump up and try to break loose. The next instant from the thick bushes like a streak of lightning the leopard sprang upon the bait and a struggle ensued. The leopard being a very large one was capable of mastering and killing the buffalo. All the time the tigress sat in the open watching her mate kill the bait. When all was over both sat side by side and devoured the kill. I was terribly excited at this sight; and with the greatest difficulty refrained from firing. I made up my mind to see whether this extraordinary performance would be repeated and to give myself another opportunity of watching it. The next day another bait was tied out but no kill took place. The following morning it was observed that the leopard and tigress had both passed close to the bait but did not kill. I was afraid that both had left the locality, and that I had also missed the chance of shooting a couple of such fine animals. The subsequent evening I sat up again, and exactly the same thing occurred. The leopard killed and the tigress, who took no part in the killing, shared the meal. Again I did not shoot. They killed every second night, and, in preparation for the next kill, I had a larger bait tied out to see as to whether the leopard would attack it or leave it to the tigress to kill. The leopard hesitated a bit this time but launched the attack as usual. The bait drove off the leopard. The attack was repeated with renewed vigour and this time the leopard got home, but the buffalo in floundering and jumping managed to fling off its assailant. Seeing her mate incapable of mastering it, the tigress attacked and killed the bait. Both again on the friendliest of terms devoured the kill. I left them in peace and returned home after they had left the kill. I sought an explanation of this strange association as to why this particular leopard and tigress lived in such intimacy. The only feasible thing that I could think of was that the leopard was a hybrid. This theory proved to be wrong as the leopard after being shot proved to be nothing more than a leopard of exceptional size. The next day I made up my mind to have a beat, and His Highness very kindly let me have the best machan. The beat began and very soon the tigress appeared. She tried to escape by a side nullah, but was turned by a stop. She came to within sixty yards of my machan when I fired hitting her just behind the shoulder. She gave a bound but fell dead to a bullet from my ·375 Holland and Holland magnum rifle. A few minutes later the leopard appeared, and when quite close was shot by my brother-in-law, His Highness the Nawab of Baoni. The tigress measured 8 ft. 3½ in. and the leopard 7 ft. 10½ in. between pegs.

Thus ended a very extraordinary and strange friendship between a tigress and a leopard. Both animals were in the soundest condition and no signs of any kind of previous crippling wounds were found on either of them.

PUNJAB. IFTIKHAR ALI KHAN,
July 3, 1936. *Heir Apparent of Malerkotla State.*

[It is difficult to explain the curious association between this leopard and tigress—except to suggest that it may be an instance of mating between the two animals. When the two species occupy the same territory, normally, there is acute rivalry between panthers and tigers on the question of food and there are numerous instances of panthers being killed by tigers in disputes over a kill. In the present instance a complete understanding apparently existed between the two animals, not only in the matter of killing prey, but equally in the division of the spoils. The natural disposition to rivalry between the two animals could have been overcome only by the sexual urge which draws animals of the same species into association—temporary or permanent and which in the present instance may have drawn together two different, though allied species. Under conditions of captivity the great cats, lions, tigers, leopards and jaguar have frequently interbred. We have instances of lions and tigers interbreeding—the most recent being the 'Liger' a cross between a lion and tiger which the Society was instrumental in sending some years ago to the London Zoo. In 1912, we sent a skin of a hybrid lion-leopard to the British Museum—the result of the mating of a large male leopard and lioness in the Kholapur Zoo. A male lion is also recorded as having bred in Chicago with a female, which itself was a cross between a jaguar and a leopard. Opportunities for such interbreeding under natural conditions must be rare but the note under discussion suggests their possibility.—EDS.]

II.—CURIOUS COMPANIONSHIP BETWEEN PANTHER AND WILD BOAR.

I wonder whether you or any member is interested in or can explain the following incidents, which happened near the Gir jungle in Junagadh. The facts are given to me by a very knowledgeable local expert in panthers, Mr. Sequeira.

He had *khabar* of a panther, and went after it. The first day a male panther, a female and a half-grown cub were marked down in a nullah. He saw them lying under a banyan tree, and three boars were lying with them, about 8 or 10 ft. away. The panthers did not come to the kill, so they had a beat. The male panther got out, from the side of the nullah; the female and cub and *the three boars* passed the guns.

Next day, the panthers, male and female, were again found in a bush, and the three boars again were lying near them. The cub was not seen. In the beat, the male panther was shot; the female and the three boars again ran, past the guns—up the nullah.

On the third day, the female and cub were lying at the mouth of a cave, with the three boars lying round them. As the female was big with young, she was not shot; but one of the boars was shot instead.

To me it would be interesting to know whether any other cases of such companionship are known.

c/o Lloyd's Bank, J. MONTEATH,
6 Pall Mall, London, S.W. 1. I.C.S. (*Retd.*).
April 12, 1936.

[A German scientist, P. Degener has endeavoured to classify all the forms of association in the Animal Kingdom. With truly German thoroughness he distinguishes 92 different categories of association, some of which border on the humorous, such as the 'association' of animals fleeing before a forest or prairie fire. To each type of association he has given names of truly German ponderosity 'Heterosymphagopaedum' and 'Amphoterosynhesmium' are two of his better efforts. His 92 categories can be summed up into two groups: one in which the association is accidental and of no intrinsic value to the associates, and the other in which the association is of some benefit. The need for food and shelter brings into close companionship individuals of unrelated species sometimes to their mutual benefit, but more often to the gain of one at the expense of another. As often as not, one creature takes advantage of another either without troubling the host over much or definitely harming it. Those that are harmful are true parasites, the others are generally regarded as commensals (i.e. feeders at the same table). More often than not one of the commensals, generally, if not invariably the smaller partner, merely robs its larger companion of some of the food the latter has gathered. Sambhar and cheetal are frequently seen with monkeys. They follow monkeys to pick up the fruits they scatter from the trees on which they are feeding. In the note under discussion, the companionship of the boars with the panther has possibly a similar explanation, these boars were probably in the habit of following the panthers and feeding on the remains of their kills. That wild boars feed occasionally on kills is supported by an incident recorded by Lt. Fitz Gibbon (*Journal*, xxi, 237). When sitting up over a goat which was killed in his presence by a panther he saw another animal walk up to the kill and stand about a yard from it looking on. He shot the intruder which turned out to be a big wild boar. He states that the boar was in no way discouraged by the presence of the panther and the panther took not the slightest notice of the boar and never paused in its eating even though the boar stood quite close to it.—EDS.]

III.—NUMBER OF CUBS IN A TIGRESS LITTER.

I would like to bring the following to your notice and if you consider it interesting enough, to publish it in your next issue of the magazine.

His Excellency was shooting in the Yellapur jungles in the Kanara Division in the month of May. The shoot was run by the Chief Conservator of Forests (Mr. Gilbert) and the Conservator, Southern Range (Mr. Hiley). There had been a kill and a beat had been arranged in the Marikari (Magod) jungle. One animal came out to His Excellency's machan and was shot by him, there was no other sign of any other tiger in the beat. The one which was killed was a very fine specimen of a female measuring 8 ft. 9 in. between pegs, height at shoulder 3 ft. 6 in. After she had been skinned five foetuses were found inside the tigress. They were all very well marked and looked healthy, there being three males and two females. From the size of the cubs and the tigress not having any milk in her teats, it was judged that the cubs would not have been born for another three weeks. As the period of gestation is supposed to be fifteen weeks, the tigress must have come into season about the end of January. Mr. Dunbar Brander in his book *Wild Animals in Central India*, page 59, states that 'Any number up to six at a time may be born, but two or three is the usual number. Best mentions a case in which as many as seven foetuses were found in a tigress'. I asked both the Chief Conservator and the Conservator if they had ever heard of or seen a similar case of five foetuses and they replied in the negative, I have seen 56 tigers killed and this is the first time I have ever seen more than four.

I should be grateful if you will let me know of any authentic case of this number or above. The date on which the tigress was shot was the 10th May 1936.

GOVERNMENT HOUSE,
BOMBAY.
May 21, 1936.

C. G. TOOGOOD,
Lt.-Col., Military Secretary.

[There are a number of records in the *Journal* of tigers with five young, either in the foetal stage or as cubs. They include a tigress shot by Capt W. St. J. Richardson (*Journal*, v, 91) and two shot by W. Forsyth (xx, 1148). J. B. Mercer Adams mentions a Karen in Burma taking five cubs from the same lair (x, 515) and R. C. Morris recorded the killing of a tigress with five cubs (xxxi, 810).—EDS.]

IV.—RATELS AND CORPSES.

I would like to make a few comments on the letters that have been recently published on this subject in the *Journal.*

Firstly, I would appeal to Mr. Dunbar Brander to bear in mind that the object of this discussion is to discover more about the life history of these most interesting and little-known animals. It is not a battle in personalities. I therefore will refrain from making more than a very few comments on his letter published in the last number of the *Journal.* My offence in his eyes is that I wrote in one of my books that the evidence on which he based his statement that the name of 'grave-digger' is 'thoroughly earned' appeared to me to be weak. This is the only point in his book on which I disagreed with him. After all, Mr. Dunbar Brander himself disagrees in his own book with many statements made by Mr. Lyddeker. I admit that he has now supplemented the evidence given in his book with further evidence, which I will comment on later. I regret that I judged what he wrote in his book on the evidence that he published in his book, because that was all he gave at that time. His actual words were 'One of their names "The grave digger" is thoroughly earned as I have known them exhume *a* (single) corpse'. In subsequent correspondence he has produced further evidence and has stated that this is 'some of the evidence' at his disposal. I can only reply that if he had originally published this other evidence in his book the present somewhat heated controversy would never have arisen.

Mr. Dunbar Brander asks me to state what personal experience I have of ratels. I admit that I have not anywhere near so much as I should like to have. I have three times come across them personally in the jungles, on two of which occasions they were entirely undisturbed. I have made a special study of their tracks, which I have followed for many miles. I have made personal enquiries from many Indians on the subject. I have made a special search in the scanty literature concerning ratels. I have taken some twenty to thirty flashlight photographs of ratels, and I have spent many hours hunting unsuccessfully for their homes. I do not know how many times Mr. Dunbar Brander has personally encountered *undisturbed* ratels, but he states in his book that he '*once* saw one come out in a beat' and 'frequently discovered them through his dogs'. From this, one inference is that he has *never* seen an undisturbed ratel.

My observations on the ratel's courage were based largely on wide reading (including Mr. Dunbar Brander's book), but one of the ratels I have personally encountered—it was walking along a jungle path early in the evening—attacked my dog with such courage and ferocity that I was forced to shoot the ratel to save the dog.

Mr. Dunbar Brander still fails to appreciate the point of my argument. I stated that it had not been proved that the exhuming of corpses was a definite habit of ratels. A habit is a characteristic common to the species as a whole. Mr. Dunbar Brander admits that ratels living in jungles like N. Kheri have no opportunity of exhuming corpses. In that case, if exhuming corpses be a regular habit of these creatures, why are they so common in such jungles? There is plenty of cultivated country largely inhabited by Mohamedans available for them to the south of these forests. From this fact it is surely a reasonable inference that many ratels can, and do, manage perfectly well without exhuming corpses.

I will now summarise the evidence that has been forthcoming since I appealed to readers of the *Journal* to send in any observations they may have made on the subject of exhuming corpses. We have at present:—

Mr. Dunbar Brander—Two cases (circumstantial evidence). One case was where ratels regularly excavated in a graveyard.

Mr. Clifford Hurst—One case (circumstantial evidence).

Lt.-Col. Toogood—One case (direct observation).

In addition to this Lt.-Col. Toogood gives two cases of ratels visiting carcases of animals, to which I can add two more cases of ratels visiting tiger kills, in one of which I took an indifferent photograph.

We have therefore four cases of ratels exhuming corpses, one case of ratels living in a graveyard, and four cases of ratels visiting kills. This doesn't seem very much evidence for the length and breadth of India. Unless more evidence is forthcoming I therefore still hold that this evidence is insufficient to support the charge of the name of 'grave digger' being 'thoroughly earned', as contended by Mr. Dunbar Brander, although of course individual ratels or those that live near graveyards naturally may do this. In support of my contention I would point out that I personally have come across at least half-a-dozen cases of sloth bears visiting kills and I know of another case in which a Himalayan bear actually exhumed a carcase near Dalhousie. If, therefore, on the evidence so far produced, the name of 'grave digger' for the ratel is 'thoroughly earned' we might equally well apply the same name to bears. Tigers are known to climb trees in the Mysore Zoo, and one or two other cases of tigers climbing trees have been recorded. Would Mr. Dunbar Brander like to suggest that tree-climbing is a *habit* of tigers—or that, because some human beings eat human flesh, the name of 'cannibal' for the human race generally is justified?

In connection with ratels I was very interested to read in Mr. Clifford Hurst's letter that he had several times seen ratels at night in the beam from the headlights of a motor car. In North Kheri and Bahraich Forest divisions, where ratels are very common and where cars frequently travel at night, I know of no case where this has occurred and the reason has always been a mystery to me, as ratels' tracks can be seen on almost every motor road in the mornings in the hot weather. I deduced that the hearing of ratels must be so acute that they hear cars coming and slip off the road too quickly to be seen, but evidently this must be a wrong deduction. Perhaps Mr. Clifford Hurst possesses an exceptionally silent car or extra powerful headlights?

Almora, U.P. F. W. CHAMPION,
July 2, 1936. I.F.S.

V.—RATELS AND CORPSES.

Nearly thirty years ago now I was in charge of the Hoshangabad Division. It was one of these years of scarcity, not amounting to Famine, and I succeeded for the most part in staving off a Gazette Notification of condition of 'Famine' consequent to which all sorts of things happened.

As is usual under these conditions, mortality was very high, and a wave of cholera passed through the forest villages under my control. I was camped in a village in the extreme western borders of the District, just after this wave had passed.

The Range Officer was one Bhote, a Parsee, a man of great ability who later on had to leave British Service, and was, I believe, eventually employed in Gwalior.

He informed me that there was a man in the village who 'Had risen from the Dead'. He had! And what is more, he believed it himself, along with all the surrounding population. I interviewed the old man—a Korku. What had happened was this. He had apparently passed out. As interments at the time were daily occurrences these were executed in a perfunctory manner: the usual heap of stones was dispensed with.

The old man informed me that whilst he was dead he remembered nothing, but that he remembered sitting up, and that he was covered with earth, and that he was looking into the face of a hyaena, to whom he said 'Hut Jao'! He could hardly have said less! He then crawled back into the village, arriving with daylight.

In those days Korku huts were contained under one continuous roof running east and west with 'main street' between the two rows. On his arrival, most of the village did a rapid exit out of the other end of the street.

These undeniable facts intrigued me, so I visited the spot where he had been interred, and came across some 16 to 20 graves of quite recent origin. Most of the corpses had been partially or wholly uncovered. This was the work of two hyaenas, five jackals and two ratels. The two first had left evidence as having been at some or other of the corpses: the ratels had been associated with all of them. The castings of a burrowing animal are individual to the species and unmistakable: it was obvious that the ratels had been the chief excavators. I had had somewhat similar evidence in the Jabalpur and Mandla districts during the famine of 1900. I had also collected ratels in the Seoni District. As I had never been so far west as I then was, I expressed a desire to make contact with these ratels, and was shown their earth that same afternoon. The dog has not yet been born that can draw a ratel from its earth; however one emerged about 9 p.m. and was shot. The stomach only revealed vestiges of an insect diet. I feel sure that now this subject has the attention of your readers, much evidence of a similar nature will be recollected, or observed in future. In the original evidence which I gave I refrained from quoting cases in which the ratel was associated with other animals, as such evidence must always be less convincing to others, although it is quite conclusive to the trained observer on the spot.

IVY BANK, BISHOP MILL,
ELGIN, SCOTLAND.
June 26, 1936.

A. A. DUNBAR BRANDER.

VI.—DO PORCUPINES SHOOT THEIR QUILLS?

Dr. W. St. J. Davis has sent us the following extract from the *Statesman*, 1st August 1936:—

'Many observers and watchers, natural historians and what not, have asserted that the popular idea that the porcupine has the power to shoot out its quills at its enemies is nonsense. Now there comes a letter from an authority whom you must consider conclusive when you learn at the end of this paragraph who he is. The writer says he has always been meaning to write to me on porcupines and their quills. It is time, he adds, that the question of 'shooting' quills was finally settled and he proceeds to settle it. Some time ago a Naga brought him a porcupine in a basket with a very wide mesh—in fact a cage, rather than a basket. As he was holding it up, showing it off, a dog jumped up at it. This alarmed the porcupine who gave his tail a powerful flick.

Quills flew out and did actually travel a foot or two horizontally through the wide mesh before they fell to the ground. I observed it from a distance of four or five feet and there is not the slightest doubt that the quills were 'propelled' and did not merely drop out. I remember being glad my eye was not in the way. This seems to be as good evidence as it is possible to get as to what actually happens.

This letter is from Kohima and is signed by no less a person than Mr. Mills himself.'

KIM.

[The porcupine's alleged habit of shooting its quills is a legend which dies hard. The belief is at least as old as Aristotle who speaks of 'creatures that shoot out their hair as for instance the porcupine' (*H.A.*, ix, 623). Pliny describes the habit thus: 'The Porkpens come out of India and Africa; a kind of Urchin or Hedge-hog they be: armed with pricks they be both: but the Porkpen hath the longer sharp pointed quills, and those, when he stretcheth his skin, he sendeth and shooteth from him' (viii, 125. Holland's version). Ælian improves upon this by adding that 'they often shoot them with so good an aim as to hurt their attackers' (Ælian N.H.M., 10). Marlowe, in Edward II (I. i, 37) alludes to this habit:—'Ay, ay, these words of his move me much as if a goose should play the porcupine and dart her plumes, thinking to pierce my breast'. Swift, in his *Battle of Books*, writes: 'Now it must be here understood that ink is the chief missive weapon of the learned, which is conveyed through a sort of engine called a quill. Infinite numbers of these are darted at the enemy by the valiant on each side, with equal skill and violence as if it were an engagement of porcupines'. For some reason or the other Buffon, the famous French naturalist, has got the credit of inventing or promulgating the belief which, like many such traditional beliefs, has grown much in the telling. So that it has been said that a porcupine can shoot his quills through planks of wood! What Buffon actually said about the matter is that 'the marvellous is pleasingly believed and increases in proportion to the number of hands through which it passes'. It is of course the erection of the spines and the occasional falling out of loose ones which has started the legend. Damaged or worn quills of porcupines quickly fall out and are replaced by a fresh crop. The finding of these discarded spines which are frequently picked up possibly contributed to the belief. In the instance quoted by 'Kim' the explanation is that the porcupine's struggles under capture and close confinement loosened some of the longer tail quills which were displaced in the action of erecting them under stress of excitement. The porcupine's method of attack has been frequently described in the *Journal* (*vide* xxvi, 283, 1038, 1040 and xxix, 831); in two instances, from personal and painful experience. In defence the animal presents its tail to the attacker, its bristling erect quills provide an effective shield and barrier. In attack, it hurls itself backwards against its victim—the action is incredibly rapid, the resulting impact drives home the array of quills with great force. The armament of the tail consists of a small compact mass of short, solid and firm quills growing at the base of the spine. These do most of the damage—the longer tail quills also come into play but being less firmly fixed, are easily displaced and left embedded in the victim.—Eds.]

VII.—ARE HARES UNCLEAN ANIMALS?

There is a very common idea among sportsmen in India that hares are dirty feeders, and, as such, are unfit for human food. As one who lives most of his life in the jungle and sometimes can get no other meat to eat but an occasional hare, I should very much like to know whether it is really true or not that Indian hares are unfit for human food. After all it is not usually suggested in England that English hares are not good food.

To the best of my knowledge hares are purely herbivorous animals and never touch human excreta that they are sometimes accused of eating. Is it because they are sometimes found round jungle camps where human excreta is often only too much in evidence that this idea has arisen? Everyone knows that jungle fowl and black partridges in the United Provinces also tend to congregate round such jungle camps, but I have never yet heard it suggested that these birds are not fit for human food, although they certainly do rake among such excreta and they may or may not eat portions of it.

The other theory is that Indian hares are not fit for human food because they harbour harmful intestinal worms that they are liable to pass on to human beings. Perhaps some medical member of the Society can inform us if it is a fact that eating Indian hares is liable to result in an attack of intestinal parasites?

Many Forest Officers like myself would like to know definitely if Indian hares are really fit for human beings to eat. I hope that this letter may result in others that will help to clear up this doubtful point.

ALMORA, F. W. CHAMPION,
UNITED PROVINCES. I.F.S.
July 2, 1936.

[That hares may feed on excreta is not improbable. Many creatures which we consider 'clean', including poultry, display this habit. Internal parasites confined to the intestines of such animals are not usually transferred to human hosts—as intestines of poultry or hares do not usually form part of human diet. Danger arises when the parasite passes part of its life in the flesh or muscular tissues of the animal, as in the instance of the tapeworm. Here again, sufficient cooking of the flesh would destroy such parasites and remove all danger of infection. The infection arises mainly from consuming underdone meat—such as beef, pork, etc.—the partial cooking of which is insufficient to destroy parasites when present.—EDS.]

VIII.—PECULIAR BEHAVIOUR OF AN ELEPHANT.

A solitary elephant on the Cardamom Hills in Travancore seems to have a great predilection for ashes and frequently visits the vicinity of coolies' lines and ash pits for a feed of ashes. On one occasion it broke open the boarded wall of the local Sub-Assistant Surgeon's kitchen to get at the ashes in the fireplace, accomplishing this by putting its trunk through the vent, and one night the elephant not only visited each of the three ash pits behind the bungalow of the manager of the cardamom estate there, but actually got half inside, forelegs in, having to kneel to do so, as we saw from the tracks the next morning.

Elephants on the Cardamom Hills appear to feed off the bark of the *Kydia calycina* tree little, in contrast to the elephants on the Billigirirangans where nearly every tree of this species in the jungle has a portion of its bark removed by elephants at one time or another.

Honnametti Estate,
Attikan P.O., *Via* Mysore,
S. India.
July 7, 1936.

R. C. MORRIS.

IX.—BISON—VARIATION IN COLOURATION OF THE EXPOSED PART OF THE SNOUT AND TONGUE.

Of two bull bison shot in December 1933 the first was the master bull of a herd in which four other bulls were counted. The exposed part of his snout was pale salmon or pinkish in colour and his tongue grey.

The second bison, which was an old solitary bull, was bagged the following day and on examination it was found that he had a grey snout and a white tongue.

It would be of interest to know if these variations in colour are usual in bison?

Tanjore.
September 4, 1936.

C. H. BIDDULPH.

X.—WHITE BISON.

With reference to Mr. A. A. Dunbar Brander's note in the last *Journal* (vol. xxxviii, No. 3) I must offer him my sincere apologies for having stated that his book *Wild Animals in Central India* contained an admission of his not having had much experience of bison. I was speaking from memory (always risky) but find that Mr. Dunbar Brander was referring to buffalo, and not bison. Both bison and buffalo are dealt with in the same chapter in his book.

'There has been no desire on my part to disparage Mr. Dunbar Brander's views on the matter, but it is again necessary to emphasise that hitherto there has been no record from the Central Provinces and Central India of the occurrence of bison similar to the remarkable specimens to be seen in S. Coimbatore.

Honnametti Estate,
Attikan P.O., *Via* Mysore,
S. India.
May 17, 1936.

R. C. MORRIS.

XI.—WHITE BISON IN SOUTH COIMBATORE.

I do not wish to add any more fuel to the controversy on white bison which has been carried on in the *Journal*, but as I can claim a detailed and extensive knowledge of these animals and the country in which they live I think a little more information may be of interest.

The existence of these bison was first established by Mr. E. E. Rannicar of the High Range, Travancore, within the last ten years. I have been told that several planters and a Forest Officer had heard old rumours of white bison but they had never actually seen them. My first trip to the country was with Mr. Rannicar and since then I have made several other trips both with friends and by myself. It was on information supplied by me that Mr. R. C. Morris paid his visit to the country, as described in his original article in the *Journal*. It is quite natural for anyone to be sceptical over a discovery of this sort, but the facts can be now confirmed by several people.

The area in which these white bison occur is, as far as my experience goes, quite small and very limited. It is extraordinary that they have never been recorded before as the country is comparatively easy of access, and is bounded on two sides by areas which have been extensively shot over, namely the area round the Kombu forest rest house in South Coimbatore, and the Kodaikanal Hills in the Madura District. The bulk of the area in which I have seen white bison lies on a low plateau of undulating hills running up to the Kodaikanal Hills and the Travancore Hills on three sides, and dropping away steeply to Kombu on the other. A river, the Taenar, runs through this plateau. I think that it is very probable that a few white animals can be found across the Travancore boundary as I have seen herds containing one or two crossing the boundary.

The whole of the area gets a fairly heavy North East—but gets no rain from the South West Monsoon. From June to September it is very hot and dry, and very feverish. In August I found that there was no water over a very large area and that those bison which were still there had all collected within easy reach of the Taenar. Many others had migrated over and round the hills to the east on what were obviously annual migration paths. I have not had time to find out where these migrants go, but it is probable that there is another patch of country in the Madura District in which a few white bison will be found.

Although reserved forest, the area is of little value to the Forest Department as owing to the short rainfall the trees up to about 5,000 ft. are nearly all stunted. There is a good deal of bamboo in the hollows but very little scrub and no lantana. Over 5,000 ft. there are occasional sholahs of evergreen forest dotted about typical grass hill land.

The poorness of the forest and the very feverish climate explain why the area has been left more or less undisturbed. From the Kodaikanal Hills it looks an uninteresting hole in the ground, and in the pleasant North East rainy season the approach from the other side can be very exasperating as there are two rivers to cross which may be impassable for several days on end. The whole area is also unpopular with jungle coolies as there are large numbers of elephants there.

There are no herds in the area composed entirely of white or light bison. There are two small herds that I know in which the majority of animals are light coloured, but in each case when I saw them last the herd bull was a good old black animal. In many other herds there are one or two white animals. I have often been asked what is the actual colour of a white bison, and it is not possible to give any definite answer. The colour of these light animals varies from a true dull white down through the duns to light reds. As these animals are certainly not normally coloured and those at the top of the scale are definite degrees of whiteness I think the name White Bison is as descriptive as any that can be found.

The majority of white animals, as is to be expected, are young animals, but I have seen several old cows which were as white as the whitest of the youngsters. Until my last visit I had never seen a white bull although an old bull in one of the herds mentioned above was a very light brown. On my last trip I was lucky enough to find a young white bull not quite in his prime without any shades of brown on his body. The local Pullyars say that there was a very fine white bull a few years ago which probably died in a rinderpest epidemic which decimated the bison. They also maintain that there were many more white animals before this epidemic and that they suffered more heavily than their normal coloured relatives. I think that they have been misled by the fact that it was easier to see white bison then owing to the greater numbers that existed before the epidemic.

In the last few years there has been a marked increase in the number of white young animals to be seen, and as the shooting of any but normal coloured bison is now prohibited it is to be hoped that this increase will continue. I have spent a good deal of time observing these animals at close quarters and can see no outward sign to suggest that this abnormal colour is due to a cross with white domestic cattle. Except for their colour these bison are in all other respects normal bison.

At certain times of the year the whole area teems with bison. There is a large salt lick in the centre of the country in the middle of a craterlike hollow which is an ideal spot for observation. It is not uncommon to see a mob of a hundred bison at this lick. The great majority of them are normal coloured animals. It is quite possible to spend several days in the country without seeing any white animals and to come away believing that you have listened to another enthusiastic exaggeration.

I am certain that the local Pullyars look upon the white bison as 'Swami' animals. They do not like to take any risk of one being shot, and will give very little help in showing them to you, in fact I have strong suspicions that they will deliberately shift a herd which contains white animals out of the area in which you are camping. Being beef eaters they have no scruples over the shooting of a black bull. The inhabitants of the grass hills on the Kodaikanal side are caste men and although they must know of the existence of white animals they denied all knowledge of them to me. I had actually passed a herd with white animals in it within an hour's walk of this village. An interesting point about these hill caste men is that I found them growing quite a good type of barley as a staple crop on terraced cultivation. Except in Ooty where it is grown for the brewery I have not seen barley grown anywhere else on the hills in this part of the world.

The whole area in which white bison are found, so far as is known at present, cannot be much more than 20 square miles. Most of it has in times gone by been extensively cultivated as nearly all the valleys contain traces of irrigation work, and a lot of the steeper land has been terraced. It has been abandoned for a very long time and is covered with teak and other trees. Presumably the combination of elephants and malaria was too much for the inhabitants. There are also any number of fine examples of the prehistoric stone dwellings or graves which are invariably built on slab rock, and are common throughout the deciduous forests in these hills.

MONICA ESTATE,
VALPARAI P.O. J. WILLIAMS.
September 24, 1936.

[A member from South India who proposes to shortly visit the district where these bison are found has asked the Society for the loan of a dormouse as a standard wherewith to check the colour of the bison. Unfortunately Mr. Williams' note indicates that precise discrimination between the various grades of colour exhibited by these animals would require the supply of many mice of nicely graded hues. Having no such mice we suggest that this correspondence may now cease.—EDS.]

XII.—SOME HOGHUNTING REMINISCENCES.

In my article on Pigsticking Reminiscences, published at page 515 of vol. xxxviii, No. 3, I was unable to include the famous Hoghunter's Song but am now in a position to repair the omission.

W. X., in a letter to the Editor of the *Oriental Sporting Magazine*, published in June 1828, wrote:—'I will offer no apology for sending the enclosed most admirable Song to decorate the pages of your first volume. I have written it from memory, but believe it to be correct as I have heard the well known author sing it repeatedly. I had the good fortune to be present at the chase that gave rise to it, and certainly if ever such a brute as a boar deserved the immortality of verse, the grey veteran we killed that morning had an unrivalled claim to such distinction, He was a perfect monster—ran with the foot of the deer and charged with the force of the buffalo—he killed one horse dead on the spot, and ripped two others very severely. With our spears all broken and our nags done up, we were obliged to dismount and sabre him. I wish you could persuade the author of the song to give you a description of that hunt from his pen: it would be highly picturesque and interesting.'

THE NEXT GREY BOAR WE SEE!

The boar, the mighty boar's my theme,
  Whate'er the wise may say,
My morning thought, my midnight dream,
  My hope throughout the day:
Youth's daring spirit, manhood's fire,
  Firm hand and eagle eye
Do they require, who dare aspire,
  To see the wild boar die!
Then pledge the boar, the mighty boar,
  Fill high the cup with me,
Here's luck to all, that fear no fall,
  And the Next GREY BOAR we see!

We envy not the rich their wealth,
  Nor kings their crowned career,
The saddle is our crown of health,
  Our sceptre is the spear;
We rival too the warrior's pride,
  Deep stained with purple gore,
For our field of fame's the jungle side,
  And our foe the jungle boar!
Then pledge the boar, the mighty boar,
  Fill high the cup with me;
Here's luck to all that fear no fall,
  And the Next GREY BOAR we see!

When age hath weakened manhood's powers,
  And every nerve unbraced,
Those scenes of joy will still be ours,
  On memory's tablet traced:
For with the friends whom death has spared,
  When youth's wild course is run,
We'll tell of the chases we have shared,
  And the tusks that we have won!
Then pledge the boar, the mighty boar,
  Fill high the cup with me,
Here's luck to all that fear no fall,
  And the Next GREY BOAR we see!

The hoped for account of that memorable hunt did not appear in the *Oriental Sporting Magazine*, but from a number of pigsticking songs signed S. Y. S., which were published in the

Magazine for several years, it is almost certain that the author referred to by W. X. was S. Y. S. Perhaps some reader may be able to give his name.

July 14, 1936. J. C. A.

XIII.—HORN GROWTH AS OBSERVED IN BLACK BUCK AND NILGAI.

(*With a photo*).

1. The very interesting note written by Mr. J. E. Hall of the Burma Shell Co., Ltd., Muzaffarpur, B. and O (*Journal* of the 15th of April, 1936, on 'Horn growth as observed in Black Buck and Nilgai') has attracted my attention. I have had considerable experience of Black Buck, Chinkara and Nilgai, as the territory of the Malerkotla State abounds with these antelopes. Black Buck are found in herds of 300 or more and innumerable smaller herds are a common sight. I find by going through records of my shoots that I have shot three hundred of these graceful animals. Some really fine heads have been obtained from the State

preserves. A head of 29½ in. was shot in the winter of 1917, and another fine specimen of 27½ in., a royal spread, was shot by me in 1926, the photograph of which is published above.

Mr. J. E. Hall states that he found 'a new growth of horns displacing the older horn from underneath and growing in the usual way'. I have myself found a black buck which I shot only last year to have the outer horns loose and shaking so that the slightest force disjointed them from the presumably raw and new growth of horns to which the old ones were joined. The covering horns were also split at the base. On being dislocated the old covers left a base ½ in. high on which they rested. This ½ in. of horny substance no doubt conveyed the idea that in time it would cover up the inner horn thus giving the animal a new pair of horns.

I could not call this case a sound basis for expressing positively the fact that antelopes shed their horns as is the case with deer. While shed horns of sambur, chital and gond and other deer are commonly found, I believe that no case of shed horns of antelope being found has ever been recorded. It would be very interesting and useful indeed if more light could be thrown on this subject by other sportsmen and naturalists.

PUNJAB. IFTIKHAR ALI KHAN,
May 28, 1936. *Heir Apparent of Malerkotla State.*

HORN GROWTH IN THE NILGAI.

2. With reference to J. E. Hall's note under 'Miscellaneous Notes' item X in vol. xxxviii, No. 3. I confirm his observations regarding the shedding of the horns of the Nilgai.

I have a head of an old bull, length of horns 8 in., in which the old outer casing has commenced splitting away from the bottom or new growth and the outer horn is of a brownish colour with numerous fine cracks longitudinally along the entire length. The taxidermist who mounted the skull has trimmed the bottom split and frayed portions away all round up to where the old and new horns meet, but in spite of this it is observed that the outer casing is quite independent of the newly grown horn.

TANJORE. C. H. BIDDULPH.
September 4, 1936.

HORN GROWTH IN NILGAI.

3. Regarding Mr. J. E. Hall's note on the above, I may mention that I have noticed a similar case in a nilgai. This animal when shot had very blunt rounded horns; the skull was kept and after a time, as it dried, the upper sheath came off like a cap, from about an inch away from the base, revealing a new horn below with very sharp points.

CENTRAL MUSEUM, E. A. D'ABREU.
NAGPUR.
July 4, 1936.

[There are three processes by which horns are replaced. The replacement is most complete in the Deer in which the entire horn is shed periodically. In deer, this shedding is a twofold process. Firstly the 'velvet' which covers the new grown antler is stripped. The 'velvet' takes the place of the horny sheath which covers the bony cores of the horns of hollow horned ruminants. The 'velvet' is removed leaving a core of dead bone which we call the horn. Next the horn itself is shed. Thus in deer the process of horn replacement involves both the outer sheath (velvet) and the core (horn).

An intermediate or less complete process of horn replacement is seen in the Prong-horned Antelope (*Antilocapra americana*). The structure of the horns of these antelopes bears a closer resemblance to the *Bovidae* (hollow horned ruminants) than to the *Cervidae* (deer), but, like deer, these antelopes shed their horns annually. But replacement is not entire as in the deer—it is limited to the horny outer sheath, the bony cores which support the horns from within are not shed.

Finally there is a process of horn replacement which has been observed in some bovines and true antelopes. Buffon observed the process in the Ox (*Nat. Hist.* t. i, iv, p. 459) and Ogilby in the African oryxes, the Arabian oryx and the sing sing antelope (*Trans. Zool. Soc.*, vol. iii, p. 53). Ogilby likens this process of horn replacement to the replacement of the milk dentition by permanent teeth. After comparing the structure of young or juvenile horns to mature bovine horns, he says that the *permanent* horn is developed, and grows up within the horn of the young animal and, in its growth, carries the outer horn upwards and supports it like a sheath or scabbard. The early horn thus severed from the vessels which formerly supplied it with nutriment, dries up and bursts as a result of the expansion and growth of the permanent horn within it. Ultimately it exfoliates and comes off in large irregular strips leaving the permanent horn clean and bare. Ogilby says that as far as his observations enabled him to judge, this exfoliation takes place only once during the life of the animal, and that at the period of adolescence, immediately before the appearance of the first ring or annulus. Mr. Hall in his note on horn growth in Black Buck and Nilgai (*Journal*, xxxviii, 618) gives an example of a new horn growth displacing the older horn from within in an immature black buck. It is parallel to Ogilby's observation of the replacement of the juvenile horns by permanent horns in the Oryx and other antelopes. Ogilby however indicated that his observations as far as they went led him to conclude that replacement of horns was limited to the period of adolescence. Mr. Hall in his note (*loc. cit.*) however indicates a similar process taking place in the case of an adult nilgai and Mr. C. Biddulph and E. A. D'Abreu confirm Mr. Hall's observation in regard to this species. The whole question raises an interesting point for observation and study by readers of the *Journal* who may have the opportunity of confirming Mr. Hall's observations on the growth of horns in the nilgai and black buck.—EDS.]

XIV.—COLOUR SENSE IN WILD ANIMALS.

Has any research been done to find out what an animal *actually sees*?

Has a wild animal any colour sense? Personally, all my research so far leads me to the conclusion—supported by nearly all the writers I have come in contact with (also hunters)—that they have none, or a very limited sense of *colour*. Dogs, for example, cannot distinguish colours however bright.

Human beings can distinguish colours between the limits of the solar spectrum from violet say $93:10^{13}$ (I use the astronomical notation, i.e., 93 followed by 13 '0's) cycles per second and wave lengths of the order of say 70,000 per inch to Red $54: 10^{13}$ W.L. 40,000.

What proof is there that an animal's eye can 'pick up' the same cycles and wave lengths?

I only know one case i.e. a Bull. And here again,—why *should* a Bull be dangerously excited by Red and no other colour? Is it possible that an animal's colour perception is *lower* than ours i.e. it can see red and *below* the Red end of the spectrum which our eyes cannot see, but is incapable of absorbing the high frequencies and wave lengths which give us the range of colours towards the violet?

MUSSOORIE, U.P. H. A. WOOD.
August 10, 1936.

[Mr. W. J. Calman, Keeper of Zoology, British Museum, to whom we referred this note, writes:—

'A great deal of work has been done on the sense reactions of mammals, but as the papers recording it are mostly in journals dealing with comparative physiology and with psychology which are not in the library of this Museum, I am unable to give you exact references without a good deal of research. I understand, however, that it is generally accepted that mammals other than the primates are practically, if not entirely, colour blind, although they may be able to discriminate with great precision between the amount of light reflected by different objects. A dog, for instance, is only able to see everything grey, but he can distinguish with great sensitiveness between the different shades of grey. As regards the familiar story of the red rag and the bull, one is not sure whether the experiment has ever been conducted in conditions making for scientific accuracy of observation.'—EDS.]

XV.—CROW ASSEMBLIES.

With reference to the note on 'the mating habits of crows' by the Chief Saheb of Ichalkaranji in the April issue, where he alludes to 'councils' held by the crow, my impression is that these meetings have as their object the selection of brides, or, more likely, the selection of husbands by prospective brides, the

Swayamvar of the Rajputs. The meetings are common just before the breeding season, and I have not noticed any during the latter half of the year.

A meeting begins by a crow or two alighting on an open bit of ground between trees (I am unable to say whether it is the female or the male bird that makes the beginning), at once followed by a series of crows one after another who come down from all directions very quietly, till a group of about twenty collect. A few of the young bloods then start hopping and strutting as if to show off, going away from the centre and back again, and after a while, begin flying away one after another disappointed. Most of these meetings end in this desultory fashion, no bargain having been struck; while on occasions, one sees only two crows lingering for a time after the others have flown, and then flying away together in the same direction.

This may be my imagination, but I have watched these meetings for some years, having seen five such within the hour in February last, and am left wondering as to what it all means. All speech making is taboo, and no cawing is ever indulged in at the meetings.

I should not be surprised if 'EHA' and others have already noticed and explained this interesting phenomenon.

The 'chastisement' meeting referred to probably belongs to a different category. It is much less common than the one I have described above, and the only occasion when I saw it was during the rains.

241, Princess Street,
Bombay.
May 16, 1936.

P. A. DALAL.

XVI.—AN ALBINO NILGIRI PIPIT (*ANTHUS NILGHIRIENSIS* SHARPE).

While I was out golfing with Lt.-Col. E. O'Brien this morning I noticed a white bird walking about in the grass on a hill side and drew his attention to it, we went nearer to have a closer view and observed that it was a case of albinism of the Nilgiri Pipit, *Anthus nilghiriensis*. It would be interesting to know if a similar case has been recorded previously. There was another pipit also there in ordinary plumage, which seemed rather inclined to mob the albino. I hope this bird becomes a permanent resident of the golf links, it will be interesting to watch it.

Montford, Kotagiri,
S. India.
May 24, 1936.

C. B. BEADNELL.

XVII.—THE INDIAN CUCKOO (*CUCULUS M. MICROPTERUS* GOULD).

For some time past I have suspected that *Cuculus m. micropterus* deposited its eggs in the nests of *Dicrurus m. albirictus*, but so far I had been unable to obtain any definite evidence, the nearest approach to proof being that of once observing a pair of these Drongos taking a significant interest in a young, but fully fledged Indian cuckoo. However, I never saw them feeding it, and as I was pressed for time I had to move on. I am now indebted to Mr. H. Storrs of Tersati Tea Estate who has the honour of having at last cleared up the mystery attached to this cuckoo's nidification in the plains of North Bengal.

Last month a pair of these drongos built in a tree near his bungalow, and in due course a young cuckoo was hatched out. Mr. Storrs thus had the unique opportunity of observing the bird being fed by the foster parents in the nest. He informed me of the event, and I was hoping to obtain a photo of the drongos feeding the young bird, but unfortunately the recent continuous rain made this impossible. On the 31st May, the cuckoo looked as if it might leave the nest at any moment. So Mr. Storrs decided to capture it alive, but as it was just able to fly from the nest out of reach he shot it, and kindly sent the bird on to me for identification.

Contrary to the information in the *Fauna* this cuckoo is a true migrant in the Duars and foot hills of Bhutan. By November every bird has left the District. The adult birds are the first to leave in August and September, and the young follow in October.

The birds return at the end of March, and the well-known call of 'make more pekoe' is usually heard about the 28th of that month. Only once in many years have I noticed a definite migratory movement, this was when out shooting on the 25th March, 1925. Numbers of birds were met with that morning, all were tired and restless, perching for a short time and then hurrying on again.

Cuculus m. micropterus is very common in the Duars and one must take one's hat off to him for having kept, so long and successfully, the secret of his nidification in the plains. On the other hand it is possible that we have much overrated the intelligence of the Black Drongo.

HULDIBARI TEA ESTATE,
DUARS, NORTH BENGAL. H. V. O'DONEL.
June 10, 1936.

XVIII.—A CUCKOO (*C. CANORUS* LINN.) INCIDENT.

In view of Mr. T. R. Livesey's remarks on his experiences with Cuckoos in the Shan States (*Journal*, xxxviii, 401-3) I venture to record my own experience which occurred on the evening of June 7, 1936, at 6 p.m.

My wife and I had gone for a walk on the hillside beyond Chota Simla when she said a biggish bird had flown into a clump of medium sized deodars below our path. Going down to investigate I heard the peculiar note of a Stonechat when a cuckoo is in the neighbourhood, and so told my wife to come and sit down to watch.

We had scarcely sat down when we saw the cuckoo perched on top of a deodar about 100 yds. away and alongside her was the male Stonechat (*Saxicola t. indica*) giving vent to what I should call a note of distress. After a minute or so the cuckoo left, closely pursued by the Stonechat (screaming the while), and settled at the top of a deodar, one of a clump, under which we were sitting.

We could now see plainly what was taking place, i.e. the male Stonechat was furiously attacking the cuckoo and to evade his onslaughts the cuckoo was forced to hop from twig to twig. During this scuffle the cuckoo kept emitting a note, something between a crack and a gasp, and once the 'water-bubble' note, so that we now were fairly certain the bird was a female. Incidentally I might mention that a Streaked Laughing Thrush was pattering about the branches just below the combatants, apparently, as often happens, to see what the row was about.

After four or five minutes the cuckoo flew to the top of a deodar sapling where her perch seemed anything but comfortable on this flexible twig. Meanwhile, the female Stonechat suddenly appeared when both she and her mate vigorously attacked the cuckoo, who now flew to a grassy bank five yards away where she stayed 'spreadeagled' with wings and tail spread on the grass while the Stonechats literally battered her head. This apparently had the effect of driving her off for she flew some distance away pursued by the male Stonechat, while I kept my eye on the female and after a lapse of a few seconds saw her disappear into the bank and remain there, so I felt satisfied her nest was there, but as it happened this was not where the cuckoo alighted but a yard further away.

Now the cuckoo, still with the male Stonechat in close attendance, returned and settled again with outstretched wings and tail, about eight inches below the spot where I had seen the female Stonechat disappear with the male literally battering her (the cuckoo's) head, being now joined by his mate which popped out of the nest. All the cuckoo did to defend herself was to turn an open beak to the aggressors.

During the melee the cuckoo worked up the bank, but details were difficult to follow, so quick were their movements, though she had effected her purpose and flew off after about half a minute when I saw she carried something like an egg away down the hillside.

We waited a few minutes to see if the female Stonechat would return to the nest but as she was now in no hurry, or her attention now fixed on the humans, we walked up to the nest and found this placed rather far down a hole (4 in. from surface). There were three of the Stonechat's eggs in the nest and a cuckoo's resting on the *outer* edge of it. Now the question arose, would the cuckoo have revisited the nest to see that her egg was safely deposited, or would the Stonechat have voluntarily or involuntarily rolled this egg into the nest?

The following points seem quite clear:—

1. The pugnacity of the Stonechats shattered the theory of the dupes being under the delusion that something in the form of a hawk was in the vicinity of their nest. This too was stressed by Livesey.

2. The Stonechats were definitely averse from the cuckoo's proximity to their nest.

3. I think curiosity, coupled with a certain amount of suspicion, impels the prospective fosterers to divulge the whereabouts of their nest, which is just what the cuckoo desires.

4. The possibility of the cuckoo, as some maintain, carrying its egg in its mouth and then depositing it in the fosterer's nest may be ruled out in this case, for had it attempted to do so its egg must surely have come to grief during the Stonechat's tornado of attacks on its head. Moreover its bill was wide open most of the time.

The above facts may be, and probably are, unusual and so I hope this note may be of interest. The Rufous Backed Shrike (*Lanius s. erythronotus*) is a common dupe of the European Cuckoo (*C. canorus*) and one cannot conceive how the cuckoo could possibly survive under a like onslaught by these comparatively strong and pugnacious birds.

The cuckoo's egg in this case was a rich salmon pink, blotched with reddish brown, unlike any I have previously taken.

SIMLA. H. JONES.
June 10, 1936.

XIX.—THE BURMESE PLAINTIVE CUCKOO (*CACOMANTIS MERULINUS QUERULUS* HEINE).

The astonishing discrimination of the Burmese Plaintive Cuckoo, that I have referred to already in another connection,[1] offers a very subtle point for consideration against the Desertion Theory.

The Plaintive Cuckoos in the vicinity of Taunggyi lay two types of eggs commonly—the one a pale blue egg marked with red spots—and the other a pure white egg marked with red spots. The two types are about equally common. Both types victimise *Franklinia* which lays eggs here of two types—the one pale blue marked with red spots and the other white marked with red spots. Both types are about equally common.

The blue egg laying cuckoo invariably deposits its egg in the nest of the blue egg *Franklinia*—and the white egg cuckoo in the white egg *Franklinia ! Someone has wonderful powers of discrimination.*

As there is no visible difference—as far as is known—between

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[1] Cuckoo Problems, T. R. Livesey, *Journal*, vol. xxxviii, p. 734.

Franklinia laying blue eggs—or white eggs, it follows that the cuckoos watching Franklinia building their nest cannot tell what type of egg the Franklinia will lay until they lay their first egg.

A blue egg cuckoo watching a pair of Franklinia building would inspect the first egg they lay. If it was white it would seem that the cuckoo refuses it and presumably goes on elsewhere in its search for a blue egg Franklinia. And *vice versa.*

In other words the cuckoo is observing very closely the eggs of the species it dupes and then exercises a very discriminating choice. *The cuckoo chooses—not the dupe.*

The colouration of the cuckoo's egg is due to the 'initiative' of the cuckoo—to its desire to the end of mimicry—which has given the perfection of resemblance achieved over countless generations.

As regards the call of the Plaintive Cuckoo, the 'twēēt-ă-twēēt' note is uttered in the cold weather, for I have heard these cuckoos calling thus in Karenni in November and December. On the other hand, I have never heard the cadence note being called in the cold season and I take this note to be a purely breeding call.

TAUNGGYI, S. SHAN STATES,
BURMA. T. R. LIVESEY.
July 30, 1936.

XX.—THE SMALL GREEN-BILLED MALKOHA [*RHOPODYTES VIRIDIROSTRIS* (JERDON)].

The only instance mentioned by Baker and Inglis in *The Birds of Southern India* where this bird was found breeding was by Sir A. Cardew in the North Arcot District on the 10th March 1885.

A nest of this bird was taken by me on 23rd April 1936 near Shiyali in the Tanjore District. The nest was situated in a very thorny bush, alongside a small river and at about five feet from the ground. The bird was seated on the nest which made identification easy. The nest appeared small for the bird and consisted of a few dry twigs and dried leaves for a lining. The nest contained two eggs, partly set, chalky white in colour and in shape blunt ovals measuring 1.12 in. by 0.88 in. The surface of the eggs was scratched by the claws of the bird.

TANJORE. C. H. BIDDULPH.
September 4, 1936.

[As to the breeding of the Small Green Billed Malkoha (*R. viridirostris*). Whistler in his Report on the Vernay Scientific Survey of the Eastern Ghats (*Journal*, xxxvii, 525) refers to LaPersonne's statement that he believed that these birds were breeding at Kurumbapatti in April and in the Shevaroy Tirthamalai area in May and June. This Mr. Whistler considered late as the series of skins obtained by LaPersonne in June contained young birds in post juvenal moult. Mr. Biddulph's note helps to confirm Mr. Whistler's conclusion. During the recent ornithological survey of Travancore Mr. Humayun Abdulali found a nest of this Malkoha with two eggs on 28 April (1933) at Ārāmboli, a locality adjoining the Tinnevelly District of Madras.—EDS.]

XXI.—INDIAN ROLLER OR BLUE JAY (*CORACIAS BENGHALENSIS* LINN.) FEEDING ON A SCORPION.

When I was touring this year in the third week of June in Bisalpur village about 31 miles from Shahjehanpur, United Provinces, my attention was suddenly directed one afternoon to a Blue Jay which dashed towards a corner of a *pakka* building situated near the roadside. In a moment the bird returned to a hacked dry branch of a mango tree nearby with a big scorpion in its beak.

The scorpion was held in the beak by its flexible tail, head hanging downwards. The bird gave a few vigorous jerks of its head accompanied by a pressing of the beak and then swallowed the scorpion head first, almost alive, in a couple of minutes.

I have often seen these birds feeding on insects in grassy or cultivated fields. It is well known that they destroy many injurious insects, and as such are considered beneficial to farmers and gardeners. Mason and Lefroy (*Memoir Department of Agriculture*, vol. iii, January 1912, pp. 155-9) give a comprehensive list of insects found in the stomach contents of this bird, but there is no record so far I am aware of a scorpion being eaten. I am not inclined to consider the incident as the outcome of hunger, because the rains had fallen and grasshoppers, beetles and moths were numerous in the pumpkin and juar fields nearby.

AGRICULTURAL COLLEGE, U. S. SHARGA,
CAWNPORE. PH.D. (Edin.), F.E.S.
July 17, 1936.

XXII.—ON THE BREEDING OF THE PIED HARRIER [*CIRCUS MELANOLEUCUS* (PENNANT)] IN NORTHERN BURMA.

The *Fauna of British India* (ed. 1, vol. iii, p. 386) states that 'Some Pied Harriers breed in Northern India: Jerdon noticed several in Purneah in July and Cripps twice in April found an egg laid on an apology for a nest amongst "Ulu" grass (*Saccharum cylindricum*) close to the Brahmaputra in the Dibrugarh District of Upper Assam'. In the second edition of the *Fauna* no reference is made to Jerdon or Cripps on this point and the Pied Harrier is described as breeding in 'Eastern Siberia, Mongolia and Northern China'. Mr. Baker adds that 'it is practically certain that odd pairs remain to breed in the North Cachar Hills, as I frequently saw pairs of birds there during July and August when out gaur or buffalo shooting. The birds were nearly always hawking over a few wet rice fields and small marshes in the centre of a vast plateau of grassland.' Harington (*Journal*, vol. xv, p. 140) saw this species in July at Saga south of Fort Stedman in the

Southern Shan States and thought it was breeding there. I can find no other records which suggest that the Pied Harrier breeds in India or Burma.

I am now in a position to confirm the breeding in Burma of this beautiful bird. On May 30, 1936, I was in camp with Mr. D. P. Lister of the Burma Forest Service on one of the huge grassy *lwins*, or open plains, which lie north of the confluence of the Mogaung and Irrawaddy rivers in the Myitkyina District. This is a favourite haunt at this season of bison, tsaing, and hog deer, the *lwins* being covered with short grass, more or less treeless, and dotted with small pools surrounded by boggy patches of thatching grass (*Imperata arundinacea*), each *lwin* being encircled by a belt of heavy forest. They are all normally burnt over in February and March and by the end of May the grass is from 6 in to 2 ft. high, and apart from the boggy patches of thatching grass, not difficult to traverse. They are the haunts of the Sarus Crane, Black-necked and White-necked Storks, the Chinese Francolin. *Excalfactoria chinensis*, Red-wattled Lapwings and a few warblers of the Prinia or Cisticola genus. Country of this kind must be very rarely visited by any European, except naturalists or big game hunters, between March and November. On May 30th we saw a male Pied Harrier hunting near our camp and on May 31st, while wandering about after hog deer in the afternoon on the Hoti *lwin*, a huge tract of grass and marsh about a mile square, we watched him flying straight across the *lwin* with something in his claws. On reaching the spot, we flushed him off a nest in a waist deep boggy patch of thatching grass, interspersed with a little *kaing* grass. The nest contained two young birds, which were just sprouting their wing quills, and an egg—the latter a dirty buffish white,[1] which I took. The young had white down on the head and shoulders and the rest of the down was in general colour cinnamon pink (iris black, cere whitish yellow, bill black, lighter at tip, inside of gape pinkish red, legs wax yellow, claws dark brown). The nest was a flat platform of grass stalks trampled in a tussock of thatching grass, about 7 in. in diameter. On three visits to the nest I could find no signs of prey, even just after the adults had visited it. On one or two occasions, when I watched the birds to the nest, I felt sure the prey consisted of frogs or insects, birds being very few and far between in the area hunted over and (as I have repeatedly observed at other seasons), taking little or no notice of the Harriers. Indeed the only birds which showed any excitement were a pair of Red-Wattled Lapwings which mobbed the Harrier on one occasion. Once, I saw, the prey was crimson in colour and may have been a plucked bird. On June 1st I watched from a little distance both the cock and hen feeding the young. If one was on the nest, it immediately flew off on the other's arrival. Several times after settling, the bird flew off and pitched in the grass a short way off, returning a few moments later with something in its claws and possibly they keep a larder from which to feed the young, as when we first found the nest one had a bulging crop and not the other. While we were at the nest, both birds kept sailing round high in air, the hen uttering a loud sixfold 'chack-ing' note which reminded me of a Magpie (*Pica pica*) or a Fieldfare. In the air I noticed the male always soared, when not hunting, with tail tightly closed. The female's tail was spread out and they could be distinguished at once by shape. Male and female are, otherwise, easy to distinguish in the field, contrary to the statement made by Oates (*vide* Sharpe, *B.B.*, ii, 173) that the 'sexes when adult are alike in plumage'. The male is clear, black and white, the female much browner with a chocolate brown head shading into dark brown on the breast and shewing brownish streaks between the black scapulars and wing tips, as well as on the lower parts, and brown on the lower surface of the tail. The female in fact looks like a young bird just moulting into male plumage. If these were typical adults, there could be no mistaking the sexes in an adequate light.

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[1] I had this egg blown three days later and it contained a young bird, which was probably within a week of hatching.

I believe, but cannot prove, that another pair of these Harriers were breeding at the northern end of the same *lwin*, half a mile away. I saw a pair twice or thrice near here but could never be certain that one of them did not belong to the pair already found nesting. On the last occasion, when Mr. Lister and myself visited the nest, we had *three* Pied Harriers, two unmistakable males and the female, circling over us at the same moment, which suggests that there were two pairs. I saw a female and later a male in this area seated for a considerable time on a tree stump, a habit not often noticeable in the Pied Harrier. We tramped many miles of *lwins*—uninhabited except by game—between May 30 and June 2 and saw no signs of other Harriers. It is however clear that this pair, if the incubation period is 28 to 35 days (Witherby's *Handbook*, vol. ii, pp. 149-157) must have started laying about 18 to 20 April, and also that May records of the Pied Harrier in Burma or Northern India may well be of breeding birds. Mr. Lister and I much regret that we had no camera with us on this trip. It is to be hoped that naturalists in Bengal, Assam and Northern Burma (where, in particular, there are many miles of similar country to that here described along the Irrawaddy and the Chindwin rivers and in the Hukawng Valley) will soon be able to confirm the breeding of this Harrier.

MYITKYINA. J. K. STANFORD,
June 4, 1936. I.C.S., M.C., O.B.E.

XXIII.—ALTITUDINAL RANGE OF THE ASHY WOOD PIGEON (*COLUMBA PULCHRICOLLIS* BLYTH.).

I send herewith the skin of a pigeon shot here in the latter part of May.

The bird appears to be an Ashy Wood Pigeon (*Columba pulchricollis*).

Stuart Baker in his *Pigeons and Doves* appears to consider it a hill bird and gives no instance of it being recorded in any place under an elevation of 4,000 ft.

I have often seen and shot this bird in the same locality at the same time of the year, but have never seen it elsewhere. As Charduar lies in the foothills of the Himalayas at a height of under 500 ft., the recording of this bird may be of interest.

I would be very obliged if you would identify the bird for me.

Charduar, Lokra P.O.,
Balipara Frontier Tract,
Assam.
June 5, 1936.

G. S. LIGHTFOOT,
I.P.

[The bird sent by Mr. Lightfoot is an Ashy Wood Pigeon (*C. pulchricollis*).—Eds.]

XXIV.—MIGRATION OF FLAMINGO (*PHOENICOPTERUS RUBER ANTIQUORUM* TEMM.) FROM NORTH GUJERAT.

Last year (*Journal*, xxxviii, 404) I recorded the one day (April 17, 1935) visit of the Flamingo to this city. Now I have to record the dates both of their arrival and departure. I have been able to trace only one other such attempt, viz., by Captain Butler, who (*S.F.*, v, 226 ff.) records from Deesa, extreme north of Gujerat, the departure of these birds. The date given by him is 20th May (1876), though he is silent on the date of their arrival. In the light of this sketchy information, the following, I hope, will be found useful.

This year, like the last, the Flamingoes arrived in the middle of April and made their temporary home in the Chandola lake. They numbered about fifty birds. Their stay terminated on June 20th, after a couple of rains.

This year almost all the lakes, tanks and rivers in this part of Gujerat had dried up which might have been one of the reasons why these birds left their usual haunts earlier and made their stay at Chandola which had a small quantity of water to enable hundreds of Sarus crane, herons, cormorants, etc., find their sustenance.

Ahmedabad,
North Gujerat.
July 20, 1936.

HARI NARAYAN ACHARYA,
F.Z.S.

XXV.—DO BIRDS EMPLOY ANTS TO RID THEMSELVES OF ECTOPARASITES?

I have read with interest Mr. Sálim Ali's article under the above heading on p. 628 of vol. xxxviii of your valuable *Journal*, of the peculiar behaviour of certain birds when in possession of strong smelling insects.

As long ago as 1903, when stationed in Darjiling, I experimented with tame laughing thrushes brought up from the nest by offering them insects which when seized give out a strong objectionable scent. The laughing thrushes dealt with were *Trochalopterum nigrimentum* and *Dryonastes coerulatus*, and the insects with the pungent excretion different kinds of bugs (*Rhynchota*).

The birds could have had no previous experience of these bugs so that their actions would be purely instinctive. They invariably seized the insect without hesitation and as soon as they became aware of the objectionable effluvium, instead of instantly rejecting them as one would have been led to expect, they started to press or rub the insect against their under tail coverts. Moreover this action was carried out vigorously and in no uncertain manner.

Later on, in the Andamans I found a young *Dendrocitta bayleyi* also reared from the nest, treated such insects in a similar manner, and still later, *Trochalopterum erythrocephalum* in Garhwal confirmed my experiments carried out with the other species.

I was quite unable to explain this behaviour, nor does the suggestion that it is done with the object of getting rid of ectoparasites seem to me a probable explanation, for if that were the object why was the insect invariably rubbed only in one place viz. near the anus?

Moreover the fact that the insect was eventually swallowed by the bird was also noted by me.

My original notes on the above subject were published in the *Journal of the Bombay Natural History Society* and will be found on p. 752 a. in vol. xix, dated 15th November 1909. I hope that Messrs. Abdul Ali and Sálim Ali will carry on this investigation and perhaps eventually arrive at the real solution of the mystery.

B. B. OSMASTON,
I.F.S. (*Retd.*).

XXVI.—WANTED INFORMATION ABOUT HERONRIES IN SOUTH INDIA.

I should be grateful if you would publish in the *Journal* an enquiry as to the locality of any heronries in Mysore or Malabar and the season in which they are in use. There must surely be some as herons and storks of all kinds are very numerous all over the country at all times of the year but in spite of much enquiry I have never been able to hear of any breeding colonies.

COOVERCOLLY,
SOMWARPET, COORG.
July 18, 1936.

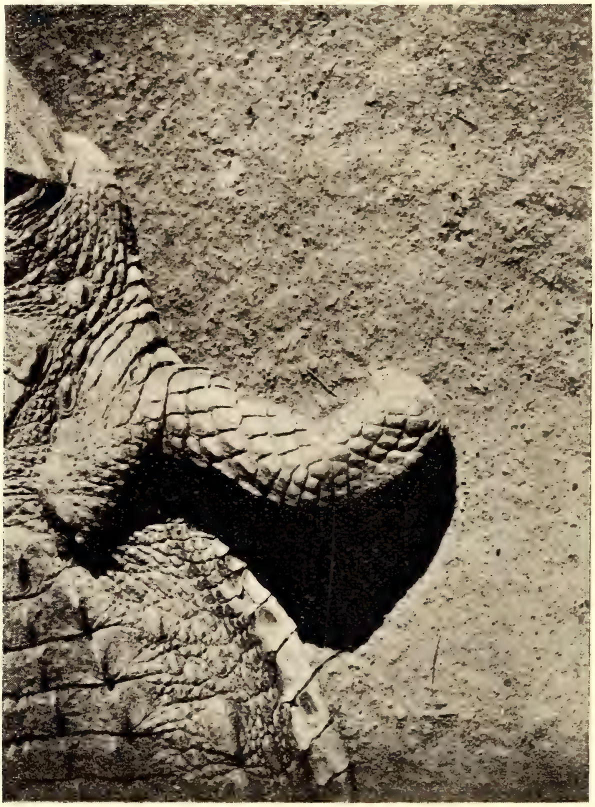
F. N. BETTS.

XXVII.—A MUGGER (*CROCODILUS PALUSTRIS*) WITH ONE FOOT MISSING.

(*With a photo*).

While on a shooting trip in the Parambikulam Valley in Cochin State in December 1934 a friend of mine shot a mugger 7 ft. 10 in. in length at an elevation of about 1,500 ft. in the Parambikulam River in dense evergreen forest.

On examination it was found that the right front foot was entirely missing, the mugger also appeared to be fairly thin. The injury had quite healed as will be seen from the photograph sent along with this note.



All the mugger seen and shot in this river are *Crocodilus palustris* whereas of the seventeen mugger shot in the rivers of the Tanjore Delta on the East Coast in 1935-36 every one proved to be *Crocodilus porosus*.

TANJORE.
September 4, 1936.

C. H. BIDDULPH.

[A crocodile shot recently in the Powai Lake near Bombay by Mr. McCann of the Society's staff, had the right fore leg missing from well above the middle or the humerus. It was apparently a very old injury and did not seem either to hinder the progress or affect adversely the general condition of the reptile.—EDS.]

XXVIII.—AN ENCOUNTER WITH A HAMADRYAD (*N. BUNGARUS*).

I was in the office one afternoon and heard my clerk's dog making a fiendish yapping down at his quarters. On enquiring the cause thereof I was informed that it was fighting a big cobra. Although cobras have been captured on the lower lying estates in this district I had not previously seen one here and was somewhat sceptical as there are plenty of very large rat snakes about. However, when I had finished my work in the office I went to investigate and found about four coolies standing round and the dog still keeping up its cacophony. Although at the first glance nothing was visible as the 'conflict' was in amongst some grown up tea, but upon a closer approach I was able to discern a section of the snake about 3 ft. off the ground between two bushes and it sent me hot foot back to the bungalow for my gun. I found I only had some old No. 8 shot cartridges and so took along my ·380 revolver. On arriving back I thought I would see if I could see the head and to this end crawled on hands and knees under the tea and saw the dog barking only a few inches away from it. I drove it away and had four shots at the snake with the revolver but all missed—a lamentable occurrence. I then thought I would give it a shot with the gun and this did not have much effect other than to make it come down sluggishly to earth when I managed to hit it with a revolver bullet in the neck. One or two facts emerge from the hunt. Firstly the extreme sluggishness and apparent docility of the snake—I never saw its hood expanded once. Secondly the striking proof that a snake is deaf to ordinary sound; it never turned an inch at the four revolver shots fired a few feet away from its head, from which one presumes it neither heard the dog; and lastly the time it took to die, although the backbone was broken at the neck it took half an hour at least before it was dead. It taped 10 ft. 4 in. before skinning and 11 ft. 6 in. after and was a male. There were numerous ticks under its scales and a large leech was found adhering to it.

I cannot account for the dog getting away with it as it did, as I was told the Hamadryad, which it proved to be, was in the open when the dog found it and the King Cobra is reputed to be the fiercest and most dangerous of Indian snakes. The bands on this snake were not well defined.

NADUAR ESTATE, VALPARAI P.O.,
S. INDIA.
June 25, 1936.

R. N. CHAMPION JONES.

XXIX.—A HAMADRYAD'S (*NAIA BUNGARUS*) NEST AND EGGS.

(*With a plate*).

1. On 7th June 1936 I was walking through fairly open moist bamboo forest at about 2,000 ft. elevation near Anisakan (some 8 miles from Maymyo) in the Mandalay District, Burma. Noticing a rather curious looking heap of dead leaves close to the rough track I was following I thrust a small cane into the heap. Immediately a snake's head shot out from the top of the heap and, as quickly disappeared. Having no gun and being with a picnic party I decided to leave well alone for the time being.

On 11th June 1936 I returned to the place accompanied by Mr. T. S. Thompson, Divisional Forest Officer, Maymyo, and some followers. Mr. Thompson and I posted ourselves on one side of the heap whilst our men cautiously pushed a long bamboo into it from another quarter. The snake soon emerged from the top of the heap and we shot it. It was a hamadryad measuring 7 ft. 5 in.

We then proceeded to examine the heap which was about 1 ft. 9 in. in height and 3 ft. 6 in. in diameter. Within this heap of dead leaves was the nest proper. It was placed on the ground and comprised a compact mass of dead bamboo and other leaves and a few small twigs and leaf stalks. Externally it measured about 1 ft. 7 in. in diameter and 9 in. deep. It was a comparatively solid structure and could be lifted off the ground without its falling to pieces. In the centre was a cup about 8 in. in diameter and about 8 in. deep.

Within the nest were twentyseven eggs, white, soft-shelled and measuring about 55 by 27 mm. The eggs were comparatively fresh and in some cases stuck lightly together. Above the eggs there was a compact covering of dead bamboo leaves which filled in the cup of the nest flush with the edges. Upon this nest, though separated from the eggs the snake had evidently been lying coiled up. The leaves forming the mound covered the snake and nest and they were lying loosely as compared with the solid and almost woven nature of the nest proper.

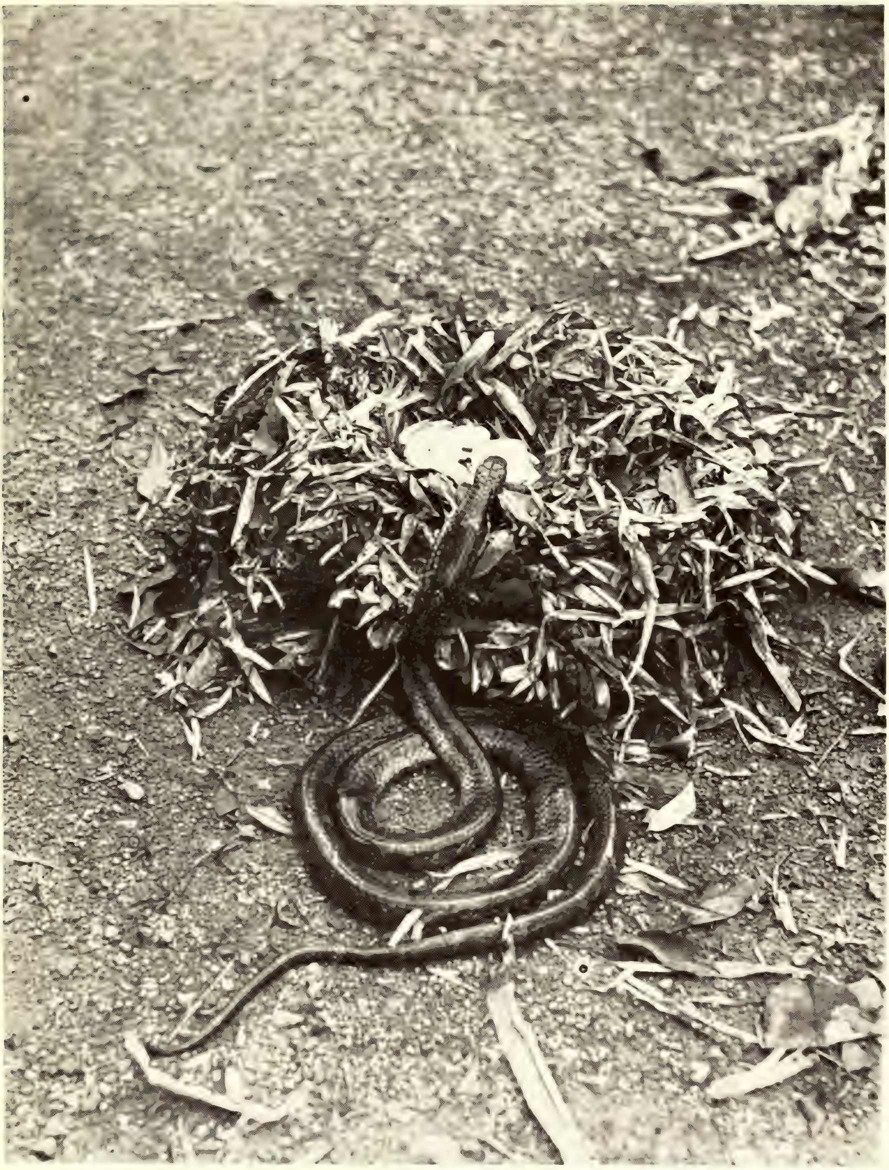
It is interesting to note that fourteen people accompanied by seven dogs twice passed at different times within two yards of the nest and yet the hamadryad failed to show itself and the nest remained undiscovered until I prodded the heap of leaves with a small cane.

H. C. SMITH, I.F.S.

A HAMADRYAD'S NEST AND EGGS.

2. The incident described below took place in July 1927 in the Tharrawaddy District of Lower Burma.

I was returning in the afternoon along a footpath to the forest rest house at Thapangyaunggyi, a small village situated on the banks of the Taungnyo stream in the foothills of the Pegu Yomas, A HAMADRYAD'S NEST.



Nest and eggs removed from *situ* with dead snake: eggs not touched and nest not unduly tampered with.

When about two miles from the village my attention was attracted by shouts and the barking of dogs in the jungle some little distance below me. On going down to investigate, I came upon two villagers with long bamboos and a couple of large hunting dogs; the party was busy chasing a large hamadryad which was moving up and down a small ditch. The dogs were rushing in from behind and attempting to bite the snake's tail and the snake with its head reared up about 3 ft. from the ground was making lightning darts at the dogs which somehow managed to evade being bitten. One of my subordinates was carrying his gun and having approached to within about 10 yds. of the snake I killed it with a S.G. cartridge, one pellet passing through the base of the snake's head. When dead, the snake measured about 12 ft. in length.

On asking the villagers how they discovered the snake they stated that their dogs had turned it out of its nest to which they then led me, about 40 yds. away. The nest was built in the base of a small shrub about 6 in. from the ground and at first sight it resembled the nest of an English magpie. It was composed chiefly of sticks and other debris and contained a hole in the top through which the snake could pass. On examining the interior of the nest I found that it was divided into two compartments, an upper and a lower storey. The lower storey which was lined with dead leaves and shaped like an ordinary bird's nest contained forty soft and rather shapeless dirty white eggs. The lower compartment was completely separated from the upper one by a layer of sticks and leaves so that the eggs were more or less in a sealed compartment.

The snake had evidently been lying coiled up in the upper compartment when first disturbed by the dogs and had emerged through the hole in the top of the nest. I should estimate that the nest was about 2 ft. from top to bottom and about 2 ft. 6 in. wide at its widest part. The villagers went home complete with snake and eggs which they intended to eat!

Maymyo. F. J. MUSTILL,
September 21, 1936. I.F.S.

[While the King Cobra has a reputation for ferocity, for the making of immediate and unprovoked attacks, the sum of recorded evidence, supported now by these notes indicates that normally, the snake behaves in the manner of all snakes and usually endeavours to escape. The few instances of aggressive behaviour in the King Cobra are connected mainly with brooding females, but it is shown in the present note that even in these circumstances the snake may not attack. All those who have seen Hamadryads during the period of incubation have remarked upon the fact that the female has been coiled upon a nest of dead leaves or rubbish. Commenting on the nest, Wall (*Journal*, xxx, 193) says: 'How this nest has been prepared, there is no evidence to show, and it would be interesting to know if the snake gathers these leaves together, and if so how. It seems most probable that she selects a chance accumulation of debris which she can appropriate for her use.' In the present instance both Mr. Smith and Mr. Mustill indicate that the nest was a compact cup like mass which could be lifted off the ground without its falling to pieces. This implies a nest, which is something more than an accumulation of leaves and suggests an effort at building. Apart from this, a new fact emerging is that the snake does not sit directly upon the eggs, but upon a compact intervening layer of leaves with which she covers them. These leaves probably shelter the eggs and help to maintain the temperature requisite for their incubation.—Eds.]

XXX.—THE GREEN PIT VIPER (*TRIMERESURUS GRAMINEUS*).

An appeal for specimens.

The discovery by Mr. and Mrs. Pope in 1933 that *Trimeresurus gramineus*, the Common Green Pit Viper, was a composite of three species was a notable achievement (*Amer. Mus. Nov.*, No. 620). It stressed in particular the value of the hemipenis as a specific character, for two of the species, namely *T. gramineus* and *T. stejnegeri*, can be distinguished from one another only by an examination of that structure, in all external characters being identical.

The distribution of the species is still imperfectly known, particularly of the two, possibly three that inhabit the peninsula of India south of the Gangetic Plain. I shall be grateful to anyone who can loan me specimens for examination. It is particularly desirable to see material from the neighbourhood of Vizagapatam, the type locality of *T. gramineus*. Exact locality of origin for all specimens should be given and living colours if possible.

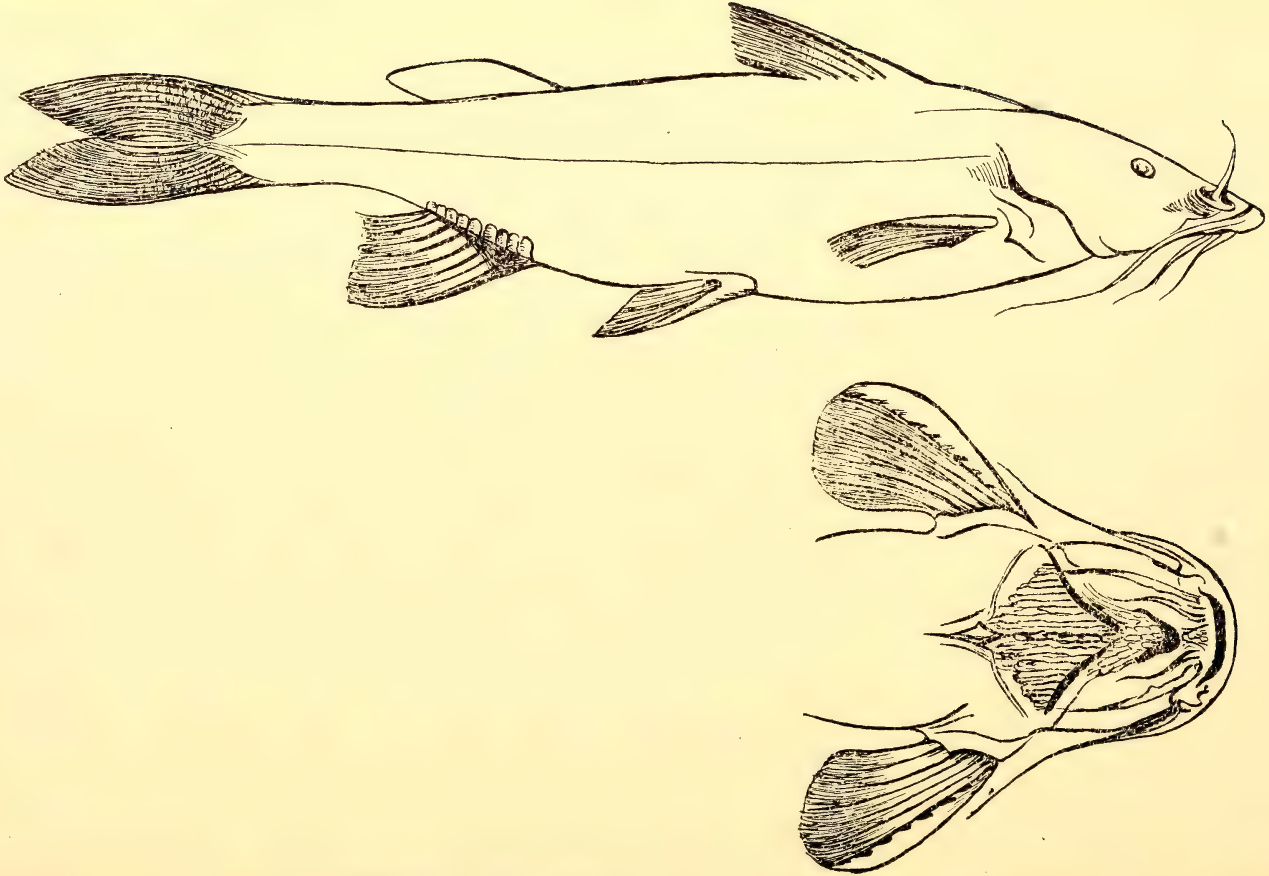
Cromwell Road,
London, S.W.
June 15, 1936.

MALCOLM SMITH,
British Museum (Natural History).

XXXI.—DESCRIPTION OF A NEW SPECIES OF FISH FROM NORTHERN BENGAL.

(With a plate).

While making a collection of fishes in the Darjeeling and Jalpaiguri Districts, Bengal, we obtained some specimens of a species of *Glyptothorax* which does not appear to have been previously described. We propose the name *Glyptothorax horai* after our friend, Dr. Hora of the Indian Museum, Calcutta, to whose generous help we are so much indebted in compiling our list of the Fishes of Northern Bengal. Our specimens are in the Indian



Glyptothorax hora sp. nov.
2/1.

Museum and the Darjeeling Natural History Museum. We append a description and figure of the fish.

GLYPTOTHORAX HORAI sp. nov.

Vernacular: Nepalese: *Kala kabri.*

D. 1/6, P. 1/9, V. 6, A. 1/9, C. 19, Barbels four pairs.

Length of the head $4\frac{1}{2}$, height of the body $5\frac{1}{4}$ in total length. Width of the head ·7 of its length. Width of the mouth half that of the head. Upper jaw the longer; a slight fringe on the upper lip. Barbels: maxillary pair extend half way along the pectoral fins; nasal reach the back of the orbit; outer pair of mandibular (the longer) reach the base of the pectorals. Teeth on the jaw but not on the palate. Fins: dorsal three-fourth the height of the body, spine moderately strong, smooth; adipose dorsal longer than the rayed dorsal and five-eighths of the interspace between them. Pectorals reach to half way between the bases of pectorals and pelvics; spines strong, flattened, with 8 or 9 strong, curved teeth internally—not plaited. Pelvics with fine transverse marking. Caudal peduncle about half as high as long. Adhesive apparatus extends from the lip to half way along the base of the pectorals. On the gill coverts it curves outwards but on the lip and thorax it consists of longitudinal folds. Laterally it does not extend quite to the pectorals. (In no other *Glyptothorax* that we know of does the adhesive apparatus extend to the lip. Colour: brownish-yellow with a dark blotch on the shoulder. Anal and caudal fins darker at base and tip. Size: Our longest specimen was 4.4 in. Habitat: Streams of the Terai (Bengal).

NAINI TAL, UNITED PROVINCES. G. E. SHAW,
June 21, 1936. E. O. SHEBBEARE.

XXXII.—ON THE DIET OF THE FISH, *RITA RITA*.

In vol. xxxvii, p. 661 of this *Journal*, Mr. Hamid Khan in his article 'Habits and Habitats of Food Fishes of the Punjab' gives the diet of *Rita rita* as follows:—'insects, their larvae and on young fishes. It also feeds even on carrion. It takes live bait, worms, chilwa or raw meat.' This may be as it may, but every specimen of *Rita* which I examined from the Nerbudda, and I must have examined a good few, had their stomachs full of young bivalves of about the size of peas and contained nothing else. The position of the mouth in these fishes in fact, suggests a molluscan diet.

CENTRAL MUSEUM,
NAGPUR. E. A. D'ABREU.
July 4, 1936.

XXXIII.—A DRAGON FLY PREYING UPON A SPIDER.

I was just about to tap a spider sitting on the edge of a leaf into my collecting jar when a dragonfly few at it with electric speed and caught it in its fore legs. I saw it feeding on the spider. Though I lost the specimen I was glad to learn for the first time that dragonflies like the solitary wasps are also among the enemies of spiders.

August 16, 1936. T. V. SUBRAHMANYAM.

XXXIV.—MISCELLANEOUS OBSERVATIONS ON THE BIOLOGY OF ALEURODIDAE (*ALEURODES BRASSICAE*).

The Homoptera belong to a class of insects known as Exopterygota or Hemimetabola in which there exists incomplete metamorphosis. But there are certain groups in this class like the *Aleurodidae* and the males of the coccidae which exhibit a well defined tendency towards the holometabolous condition. The sequence of events in the development of stages in the life of the Aleurodidae is as follows.

From the egg hatches out a larva which is quite dissimilar to the parent. It is not called a nymph but a larva of the 'oligopod' type, Imms (1931). It is active for some time and then settles down at one place, grows and moults. Then follow two more fixed, but actively feeding stages. These grow and moult, and then comes the fourth instar which is said to be equivalent to the pupal stage of a holometabolous insect. Let us first see what is meant by a pupa and consider whether those conditions hold good here. A pupa is the term applied to the resting inactive instar in all holometabolous insects, during which stage the insect is *incapable of feeding* and is externally quiescent. In the Aleurodidae after the third moult, the larva of the fourth instar is flat and thin. The upper cuticle is so translucent that the white outline of the future adult inside can be clearly seen from outside. Evidently this is not the resting stage as it is seen to feed and drops of liquid excretion are passed out of the vasiform orifice and are shaken off intermittently by the lingula. This stage also grows in thickness and becomes convex in form. The cuticle hardens and the adult inside gets loosened from the cuticle. This development of various parts of the body goes on inside. The wings begin to develop from the internal buds and after the full growth is complete the adult breaks open the upper cuticle and emerges. When the cuticle hardens and the internal development begins, the instar appears to be in a resting condition and not to feed. *This latter part of this stage* (fourth instar) *can be said to be the pupal stage*, as it behaves like a pupa defined above. The only type of pupa it can be compared with is the Coarctate type. But in the latter also a very thin pupal skin is seen to exist under the hard outer cuticle after the emergence of the adult, i.e. there is a true pupal skin in the puparium, while here there is found no moult or skin in between the upper cuticle and the adult skin as has been ascertained by dissecting a number of pupae at different periods during development. In the sections taken by Hargreaves, he also found only two skins, one forming the outer cuticle and the other forming the adult skin. At no other period does this instar behave like a pupa and at the latter part this stage may be called a Rudimentary pupa (as Dr. Imms has named it in his *Text-book of Entomology*, p. 188).

LIFE-HISTORY AND HABITS.

1. *A. brassicae.*

Egg laying: After the manner of Aleurodids, this species has generally the habit of laying in circles or semicircles, but some flies lay irregularly, laying two or three eggs at one place and then moving to another place without any apparent external disturbance. At many places the female seems to have settled for some time, but afterwards has moved to another place without laying any eggs. Such places can be easily marked out by the white powder sticking there, being brushed from the abdomen. The places chosen for egg laying are always on the underside of leaves, in the pockets between the veins and near the midrib. In circles the eggs are usually in single rows but rarely I have seen them in double rows. They are always laid with the tip towards the centre. The method (as has been described by many authors) is due to the fact that the female sits at one place with the rostrum imbedded in the tissue and this serves as a pivot—she thus moves round and round and lays one by one, the radius of the circle being the distance from the rostrum of the female to the tip of the abdomen. Eggs freshly laid are covered with powdery meal. The stalks are imbedded into the leaf tissue and as a result the eggs are difficult to remove. For egg laying generally tender leaves are preferred, but still I have seen eggs laid on older leaves and rarely on the upper side. Naturally these eggs on the older leaves frequently cannot survive as the leaves drop before the flies are mature. The number of eggs in a semicircle varies from 3 to 4 to 25 or 28. Eggs develop on leaves cut off from the plants, but the period of hatching extends. The colour of such eggs also deepens, the shell becomes harder and there is a greater percentage of death while hatching.

Development and hatching: Eggs freshly laid are sulphur yellow and shining. The orange bodies can be very distinctly seen through the shell. From day to day the orange bodies appear to change position, sometimes appearing at the bottom, sometimes in the middle and sometimes at the other end—evidently caused by the movement of the larva inside. On the sixth or seventh day the colour of the eggs becomes brown and two or three days later the larva inside begins to be formed. Six or seven days before hatching, the red eyes of the larva inside can be clearly seen through the shell, and three or four days before hatching a longitudinal crease on the egg shell, more often in the middle, is noticed. It is on the line of this crease the rent in the egg shell appears through which the larva emerges. First the cephalic portion emerges. As the larva pushes itself from inside, the rent becomes larger to facilitate the complete eclosion. The egg is laid perpendicular to the leaf surface but soon after it bends down and lies horizontally. The delicate larva can thus get a foothold on the leaf and easily extricate the rest of the body. In the few cases where the eggs are standing erect on stalks, the hatching larva has to bend out till it gets hold of the leaf and under these circumstances larvae have been observed to die if they fail to get any foothold. Similarly I have seen many larvae dead half in and half out of the shell without any apparent cause. The percentage of deaths in hatching is higher in the case of eggs on dry leaves than in those on living plants. The time required for complete eclosion of the larva from the egg shell differs in different larvae. I have observed them to take 45, 55, 65 and even 90 minutes, and when a longer time was required the part of the body of the larva outside the egg used to secrete wax particles. If hatching was effected earlier, the wax did not appear till later.

Mating: It is always the male that goes in search of the female and not vice versa. The male as it comes near the mate, feels with the antennae and tries to come as near as possible abreast on the left side of the female. Then it begins to move its wings and passes them under those of the female. Then after coming very close it moves its hind portion of the body and feels the hind part of the female. If the latter is ready for pairing it moves its hind portion of the abdomen and ultimately the copulatory organs join. The hind part of the female is held tightly in between the claspers of the male, then the fluttering of the wings and the movement of the body goes on. If the female does not want the male, she remains passive, then the male goes to another female. The copulations I have seen did not last for more than ten minutes. Leaving that female, the male began searching for other females. Before mating the eggs are always developed inside the body and the orange colour of the eggs inside the ovary can be seen from outside.

Phototropism: The flies seem to be positively phototropic and negatively geotropic. If the flies are enclosed in a glass jar in a mass of leaves, they will always congregate on the exposed parts which are turned towards the light. If they are liberated they will run to the glass panes of the windows. In cages they are always seen crowding on the part towards the light. Between sunlight and electric light in a room they are more attracted by the yellow electric light. This is in accordance with the observations of Lloyd (1921) that yellow light is preferred by the flies to any other kind.

Feeding: The adults evidently feed, as can be seen from the observation that the flies kept without any food material to feed on succumb in three days, while on a semi-dry material they eke out their subsistence for five to seven days. If they are provided fresh material they live for a long time. If starved for some time and then allowed on to plants, they feed and live on. While the fly is on a plant, it can be seen fixing its rostrum into the plant tissue and sitting at one place for a considerable length of time even three to four days.

Longevity: Immediately on emergence an adult female of *A. brassicae* was enclosed in a glass jar with a branch of the plant to feed on. The fly survived in the cage for 91 days. In the case of *T. vaporariorum* one female lived for 95 days. During these periods they were normally feeding and laying. Males were always short lived.

Egg laying capacity: The number of eggs laid varied in different species. In *brassicae* I have observed that the number laid by one female varied from 56 to 68. In *vaporariorum* the number of eggs laid by one female was 103. Egg laying is not started immediately after emergence, but generally there is an interval of one week or ten days before the female begins to lay. The number of eggs fully developed inside the body at one time is 10 to 12. In spring the life history takes a longer time than in summer. Egg laying is very prolific in summer, but as the cold weather sets in egg laying is retarded. The reason is that the development of the ovaries is stopped. I dissected a large number of females and the eggs were not at all developed in the ovarioles during colder months.

Resistance to cold temperature: The flies seem to be very resistant to low temperature, the only effect on them being that their activity becomes less, their breeding is stopped, but their feeding goes on. The lowest temperature in the greenhouse where the plants have been kept was 1°C. but this was not constant. In order to see, therefore, as to how far the flies can stand continuous cold temperature and if they were affected, was it due to the temperature or the lack of food, I experimented as follows:—

(1) Two lots of 10 flies each were kept at 1°C. in a refrigerator in two glass topped boxes. All the flies were dead on the fourth day. No feeding was arranged for.

(2) Two lots of 10 flies each were kept at 1°C. with a fresh leaf of cabbage inside the boxes for 5 days. In one 7 flies were living and in the other 6. All the living flies died after three days from the time they were taken out. The leaves had withered.

(3) Two lots of 10 flies each were kept at 1°C. for 8 and 15 days respectively with sufficient quantity of food. The flies were quite happy in both the cases.

This shows that it is not so much the cold but the lack of food that kills the flies and they can stand 1°C. temperature for a fortnight.

[This work was done at the University of Edinburgh under the guidance of Dr. C. B. Williams, sc.d.]

College of Agriculture,
Poona.
V. G. DESHPANDE,
m.ag., ph.d.

June 10, 1936.

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XXXV.—DOES THE GIANT WOOD SPIDER (*NEPHILA MACULATA*) LIVE MORE THAN ONE SEASON?

The Giant Wood Spider (*N. maculata*) is an extremely common species in the forests of Salsette Island. Towards the end of the rains it is in evidence everywhere and its great golden, glutinous web frequently forms an obstruction across jungle paths. With the approach of the cold season there is a decided decrease in their numbers and by the hot weather they have completely disappeared. What happens to them? It might be suggested that these spiders aestivate. If this were so, then during the next monsoon we should find numbers of adult spiders about the forest. As far as my observations go, they cannot support this supposition. No adult *Nephila* are to be seen during the early part of the rains, but young are about in plenty everywhere. They gradually increase in size till again we have the forests tenanted by large females hanging in their webs. This seems to indicate that the adults die out each year after a short span of life, to be replaced the following season by their brood! Further observation is necessary before this can be *definitely* proved. Perhaps the span of life may vary in different localities.

Bombay Natural History Society,
6 Apollo Street, Bombay. C. McCANN.
September 15, 1936.

XXXVI.—PARENTAL CARE AND CANNIBALISM IN ARACHNIDS.

On p. 411, vol. xxxviii of the *Journal*, Mr. E. E. Green makes a reference to and answers the old question, 'Do young scorpions eat their parent?' Mr. Green gives a very good reason why young scorpions would find it difficult and perhaps impossible to eat their mother, namely, on account of the tender condition of the young and the strongly chitinous plates of the mother—she would be a tough joint!

On several occasions I have found mother scorpions of the genera *Buthus* and *Palamnaeus* with young in various stages of development. The degree of development varied from the tender, creamy white, unchitinised young to young almost half the size of the parent, with chitinised plates fully developed. In all cases the young when not crowded together on the mother's back or near her would always retire together with her when disturbed. In all such cases the adults and young were in the best of conditions. This being the case I do not see any necessity for the young to exhibit cannibalistic propensities. If occasion did arise for such behaviour it would result from extreme hunger only, or there is another alternative possible, namely, the death of the parent or the young might occasion cannibalism, in the same way as ants of a species will eat their dead comrades, but I do not think that the young would deliberately kill the parent or vice versa. Eating the dead of the same species is of frequent occurrence in Nature.

Mr. Green, on the other hand, refers to his captive scorpion eating her offspring. Referring to this incident he adds, 'I do not suppose that this is a natural habit'; nor do I. Though provided with insect food, it seems possible that the insects were not of the right kind, in which case the cannibalism of the parent was occasioned by extreme hunger. Most female Arachnids are, as far as I am aware from actual experience, very solicitous of their egg and young.

Among the centipedes, parental care is strongly displayed by the commoner species of *Scolopendra*. In this case the female 'broods' her eggs by coiling her body round them. When the eggs are hatched she treats the young for a considerable time in the same way. If disturbed she very reluctantly leaves her charge but will soon return to it. If the eggs or young are exposed she will remove them to a place of safety. The young of these centipedes remain with the parent till well chitinised. The problem of their food is yet another matter. It seems probable that the parent brings food to the young at night, but further evidence is needed to prove this point.

Millipedes, unlike the centipedes, do not appear to 'brood' their eggs or young. In this case, a domed structure is constructed by the parent and a single egg laid within. Within this chamber the young millipede is hatched. How long it remains within its nursery is difficult to say. How it obtains its food is another problem as there is no entrance to the chamber!

The parental care exhibited by spiders is well known, but this varies in many directions. Some make a cocoon and are indifferent to its after care, others carry the cocoon about with them till the young are hatched, and others still not only carry the egg case but the young also till they are able to fend for themselves. A species which carries her young clustered round her abdomen is the large spider [*Heteropoda venatoria* (?)] commonly found in houses in Bombay. I once removed the egg case of the spider. She ran away but soon returned to the spot to which I had removed it, obviously to look for it. On my approach she again made off. I then got ahead of her and presented her with the egg case at the end of a pair of forceps, she immediately seized it. I then removed it again and placed it on the ground and watched. The spider immediately began to search for her egg case and eventually found it. She seized it and made off. I did not disturb her further.

While on the topic of spiders, I should like to refer to another phase of the Arachnid life, 'Do female scorpions and spiders eat their ''husbands''?' This is as common a belief as the one mentioned above, but definite proof is yet awaited. The males of many Arachnids, particularly among the spiders are insignificant beings when compared with their females. They are small in size and frequently most unlike in general colour and form to the gentler sex. Their sole purpose in life appears to be the fertilization of the female, which, according to belief, they achieve at great personal risk—the risk of being ignominiously devoured! Among the web building spiders, the males usually keep to the peripheral portion of the web as though they were really afraid of their larger spouses. Woe betide one of these 'bridegrooms' if he come within the grasp of his 'bride'. Are these males so foolish as to lay themselves open to such a fate? They are not so easily caught anyway. On her approach they move off to another quarter of the web—then again they are 'microscopical' to be dealt with easily and by far more active. Whether prospective 'bridegrooms' are eaten or not I am not prepared to answer definitely, but I shall relate a small observation and leave the reader to form his own conclusions, and then ask a question myself.

When going through the forest I came upon a female of the Giant Wood Spider (*Nephila maculata*) which had just cast its skin. She hung quite limp and helpless from the centre of her web—quite unable to move even when touched. Round about her were several males—all prospective 'bridegrooms'. The males chased each other about the web and away from the female; it was evidently a contest for superiority and possession of the female. In due course one of the males copulated with her. While copulation was in progress the unsuccessful males climbed all about the pair, but their action did not in any way disturb them. Unfortunately being pressed for time I could not complete my observation. Now for my question: Is it usual, when there is a disparity between the sexes in size for the males to avail themselves of the period of ecdysis to copulate? If this is so, then the males are not so imprudent as it would appear! They would have ample time to escape before the females became active. Further evidence is also required before we can definitely establish whether the males of Arachnids fall victims to the females when captured by the latter. There is the alternative suggestion that once the males have fulfilled their purpose in life they become exhausted and die, and it is then that the females finding the dead or dying utilise them as food in the same way as ants do.

In the Scorpions we do not find such a disparity in the sexes—there is really very little. This being the case I am disinclined to accept the belief that females devour the males after copulation till evidence is forthcoming. That fights occur between individuals and the vanquished is eaten is no proof that the males are eaten by females. I have kept separate cages of *Buthus* and *Palamnaeus* and the individuals in each cage lived together for a considerable time on amicable terms. This does not support the belief that scorpions are cannibalistic in the true sense of the word—that they deliberately kill each other for food unless pressed by hunger. 'A kingdom divided against itself must fall' and this is very seldom the case in Nature.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
September 13, 1936.

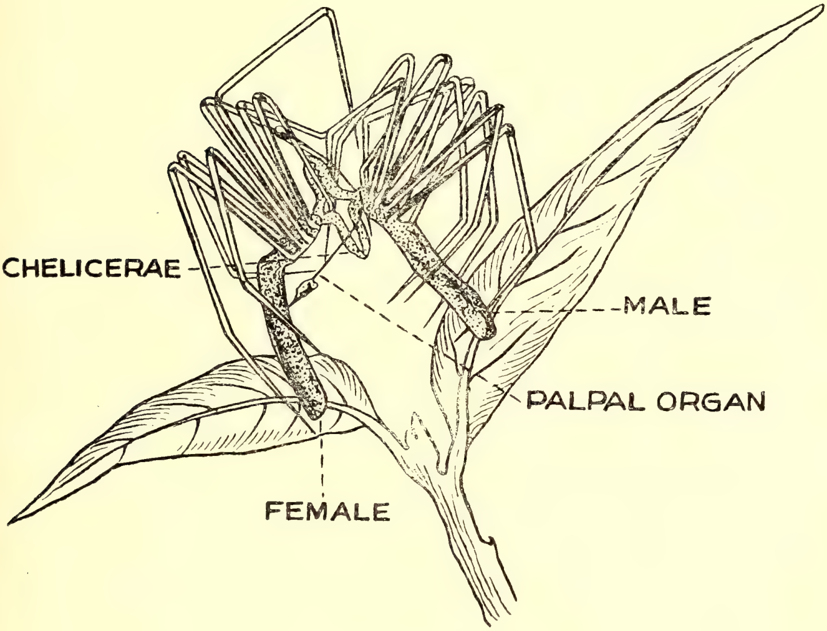
C. McCANN.

[Since writing the above I came across another instance of this nature in which copulation was effected during the limp period of the female following ecdysis.—C. McC.]

XXXVIII.—MATING OF THE SPIDER TETRAGNATHA.

(*With a sketch*).

While I was engaged in collecting spiders from among the foliage of a short graft mango tree I was surprised to see a male *Tetragnatha* speeding along one of the branchlets. I drew back and watched its course. In a moment he had grasped a partner in his hands. The partner was a female of about his own size. Her colour was more attractive than his dull brown hue. She yielded to his clasp and never showed any sign of running away from him. They stood facing each other. Their chelicerae met along their edges. In this position they seemed to remain comfortably. The female slightly tucked her abdomen towards her mate. The male began to deposit the sperms into her orifice with his palpal organs. But in doing so he did not use both the pedipalps at the same time. At first he used his right palpal



MATING OF TETRAGNATHA.

organ for about a minute. Then he removed it and used his left. In another minute he displaced his left with his right organ once more. Thus the process went on for about three minutes. Then they separated and the male dropped down to the ground by its thread.

T. V. SUBRAHMANYAM.

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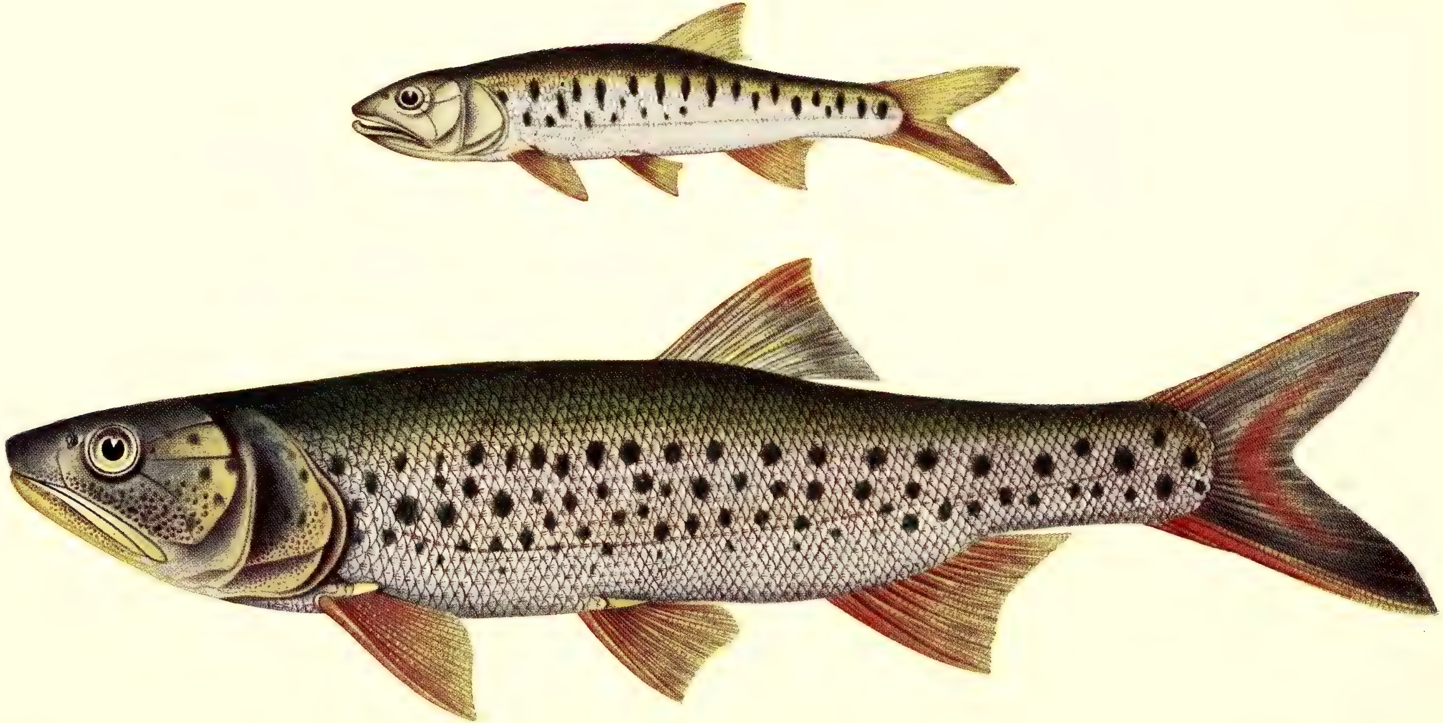

THE INDIAN TROUT
Barilius (Opsarius) bola Hamilton

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THE GAME FISHES OF INDIA.[1]

BY

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(*With one plate and 3 text-figures*).

Prefatory Note.

For a number of years the Editors have been urging me to contribute to the Society's *Journal* a series of articles on the Game Fishes of India on the model of Mr. Stuart Baker's excellent series entitled 'The Game Birds of the Indian Empire'. Unfortunately the taxonomy of Indian fishes, especially of the freshwater forms, is in a state of great confusion and in some cases it is not even possible to define the precise generic and specific limits of the commonest forms, such as *Mahseer*, without a great deal of preliminary spade work. As enquiries are very often made regarding the habits and habitats of these fishes, it has been considered desirable to start the series, giving as much information about each species as is available. It is hoped that these articles will induce anglers and others interested in the subject to contribute their experience to the pages of the *Journal*, so as to enable us to have a better knowledge of these valuable fishes.

In writing up this series I shall first of all deal with forms of which I can easily obtain coloured sketches or about the taxonomy of which there does not appear to be much confusion. The order of the treatment of the various species will, therefore, not be in accordance with the systematic position of these forms.

I.—'THE INDIAN TROUT'.

BARILIUS (OPSARIUS) BOLA HAMILTON.

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JUN 2 1937

INTRODUCTION.

The fondness of the Europeans for Trout-fishing is so great that even in India where no true Trout (Family: Salmonidae) existed before their advent, as a result of persistent efforts, two or three varieties of trout have now been introduced. Loch Leven Trout (*Salmo levenensis*) was the first to be imported and acclimatised into the Nilgiri Hills in the seventies of the last century (**9**).[1] Since then true Trout have been introduced into several other localities along the Himalayas where their culture is proving a great success. It may be remarked that in their natural state the nearest locality to India where they exist is the northern slope of the Hindu Kush in Afghanistan (**15**). There are in Northern India certain species of Carp which resemble true Trout either in form, lepidosis, colouration or sporting qualities and for these reasons they are commonly called 'Trout'. Such fishes include the 'Indian Trout',[2] known in scientific literature as *Barilius bola* Ham. The origin of the popular name and the relative qualities of the fish are thus described by Thomas (**23**):

> 'I have called it the Indian Trout, because it is commonly thus called in Northern India. Other competitors there are for the name; but *Barilius bola* seems to have the best title to be called the Indian Trout. To avoid confusion, therefore, we will commence by deposing the other fish which seem to have less right to the honourable distinction. *Oreinus richardsonii* has, according to Day, been called the "Kemaon Trout". "In some specimens there are black spots on the sides and head." Of *Oreinus sinuatus* Dr. Day writes in his *Fishes of India,* "some have scattered black and occasionally red spots, and these have been termed Trout". But this fish has a sucker with which it adheres to rocks, which is most untroutlike, and Dr. Day tells me it will not take a fly at any price, a piece of wrong-headedness for which, with your concurrence, it should be shorn of its brevet-rank, in spite of its red spots. *Oh formose puer nimium ne crede colori*—we will degrade you in spite of your looks. "Handsome is that handsome does" is the better rule, and as *Barilius bola* sports like a trout, as we shall see, let us allow his claim, though he has no adipose dorsal fin like the true trouts (Salmonidae). We may have the less hesitation in confirming the honorific as there are no indigenous trout in India.'

All along the Himalayas the small-scaled Barbels of the genera *Schizothorax* and *Oreinus* (Schizothoracinae) are sometimes termed 'Trout', but with these fishes we shall deal sometime later. Reference may, however, be made to the fact that there is a great superficial similarity between the Schizothoracinae and the Salmonidae and that the features of resemblances between them have been independently acquired under the stress of similar environmental conditions—rapid-running water over a rocky bed (**1**).

TAXONOMY.

Nomenclature.

As is unfortunately the case with a number of our well-known Game Fishes, such as *Mahseer*, the taxonomy of the 'Indian

---

[1] Numerals in thick type within brackets refer to the serial numbers of the various publications listed in the bibliography at the end of the paper.

[2] In some parts of India, especially the Eastern Himalayas, this fish goes by the name of 'Hill Trout'.

Trout' is also involved in a great confusion. It was originally described by Hamilton (**13**) in his second division of *Cyprinus* which he termed *Barilius* and defined as follows:

> 'Fishes of the genus *Cyprinus*, with the body very long and much compressed; with the sides irregularly marked with numerous incomplete transverse bars or spots; with the back fin placed considerably behind the middle of the fish; and with one lateral line at least running parallel to the lower edge of the fish.'

He further observed that

> 'The fishes of this division, on account of the numerous spots or marks on their sides, have a considerable resemblance to our Trout, and, by the English in Bengal, some of them have been considered as belonging to that genus; but they have only one fin on the back.'

Among the species included by Hamilton under *Barilius* are: (1) *Cyprinus barila*, (2) *C. chedrio*, (3) *C. barna*, (4) *C. vagra*, (5) *C. bendilisis*, (6) *C. shacra*, (7) *C. cocsa*, (8) *C. chedra*, (9) *C. tila*, (10) *C. bola*, (11) *C. goha* and (12) *C. tileo*. The majority of the species in this group are of little value, but in the case of *C. goha* Hamilton says:

> 'I have found this fish in the Kosi, Yamuna, and Son rivers, where it is called a *Trout* by the English. It grows to about the size of a herring, and is a fine flavoured delicate fish, somewhat resembling in taste the *Smelt* of Europe.'

Though Hamilton published the drawings of only two species of *Barilius*—*Cyprinus bendilisis* (4) and *C. cocsa* (**13**)—very fortunately there are drawings of seven other species in his collection of MS. drawings (**14**) now preserved in the library of the Royal Asiatic Society of Bengal. Of these MS. drawings, three were published by Gray (**11**) and five by McClelland (**20**), while two species—*C. chedrio* and *C. tila*—did not have any illustrations. It is beyond the scope of this paper to discuss the precise specific limits of all the species enumerated above, but it may be indicated that certain authors (**9**, **12**, **17**) have regarded *C. bola* and *C. goha* as conspecific, while some others (**2**, **5**, **6**, **20**) have considered them as separate species. The conflicting views on this point may now be elucidated.

Of *C. bola* Hamilton says, 'It grows to four or five inches in length, and is little valued.' He found this species in the Brahmaputra 'with many oblong diffuse spots, and a longitudinal golden stripe on each side.' His *C. goha* is provided 'with many diffuse scattered spots on the sides', and grows to a much larger size. 'In other respects it has the closest resemblance to the *Bola* just now described; and I have only in addition to state, that the spots on the sides of the *Goha* are more numerous, more irregularly scattered, and rounded than those on the *Bola*.' These observations are fully borne out by his drawings of the two species.

Authors, who had series of specimens of these forms for examination, came to the conclusion that *C. bola* merely represents the juvenile stage of *C. goha*. Mukerji and I (**17**) recently studied this fish in its natural surroundings in the Dehra Dun hills and showed how the colour varies with age. In the colour drawings of the two Dehra Dun specimens reproduced here the juvenile and the adult colouration are clearly brought out. These show conclusively that Hamilton's two species must be regarded as conspecific. As *bola* is described before *goha*, it has priority over *goha* for the purpose of scientific nomenclature and this is why the 'Indian Trout' has been known as *Barilius bola*. After Hamilton, McClelland (**20**, pp. 297, 298, 419, 420) referred to these fishes but placed them in a new genus *Opsarius* along with a very diversified group of species. The genus was characterised as follows:

> 'Mouth widely cleft, body slender, and usually marked with transverse green streaks or spots, dorsal small without spine, and placed behind the middle, anal long, lower margin of the body more arched than the upper.'
>
> 'Obs. Intestine very short, and extends almost straight from the stomach to the vent.'

He made some observations on the morphology and bionomics of the fishes of this composite genus, and described Hamilton's *C. goha* as *Opsarius gracilis* and *C. bola* as *O. megastomus*. Of the latter he had no specimen for examination and referred to its characters as given by Hamilton; while the former—the *Korang* of the Assamese—is described in some detail. Concerning this species McClelland remarks:

> 'This species occurs in all parts of Assam, in the Kosi, the Jumna, the Ganges and the Soane rivers; in which last Buchanan says it attains the size of a Herring, and is called Trout by the English, chiefly from the spots on the sides, and its fine flavour. For the latter I cannot answer; but as the species of this group are not much esteemed by the natives, I suspect it owes its imagined sweetness, in some degree, to its supposed resemblance to Trout. Notwithstanding the beauty of its appearance, its habits are such as to render it very objectionable in fish ponds.'

Both Cuvier and Valenciennes (**6**) and Bleeker (**2**) referred to Hamilton's two species as distinct forms, but they had no specimens for examination.

In 1858, Blyth (**3**) described *Leuciscus salmoides* from Allahabad and defined it as follows:

> 'Affined to *L. goha* (*Cyprinus Barilius goha* B.H., v. *Opsarius gracilis* McClelland); but larger and deeper in the body, with the spots smaller, much more numerous, and more regularly disposed, many of them occurring below the lateral line, and others on the opercula and praeopercula: upper lip studded with pores.
>
> D. 10; A. 13; P. 14; V. 9; C. 18.
>
> Lateral line composed of 88 to 90 scales; and oblique series of 26 scales descending from anterior base of dorsal. Length of specimen 11 in.'

The larger specimen figured here from the Dehra Dun hills possesses all the special features noted by Blyth for his species, and is about 11 inches in length. But there can hardly be any doubt about its identity with Hamilton's species.

Steindachner's (**22**) description of the 'Indian Trout' is based on young specimens from 5 to 7 inches in length and his determination of the species as *Barilius goha* is based on Gray's drawing (**11**) in the *Illustrations of Indian Zoology*.

Günther (**12**), who examined young, half-grown and adult specimens of the species, was the first to combine Hamilton's two species into one and on account of its very wide mouth, extending beyond the eyes, he separated it into a new genus *Bola* and designated the fish as *Bola goha*. Except for the width of the mouth there is no other special feature in which his genus differs from *Barilius*. He also indicated that *Opsarius* McClelland (in part) is a synonym of *Bola*. Day (**7**) pointed out that *Bola* Günther is 'preoccupied by Genus VI in Hamilton Buchanan's *Fishes of the Ganges*, p. 73', and instead revived *Opsarius* McClelland to accommodate Hamilton's *Cyprinus goha*. In his later works, however, Day (**9**, **10**) did not consider this species generically distinct from other members of the genus *Barilius*, and accordingly regarded *Opsarius* McClelland as a synonym of *Barilius*.

In 1918, however, Jordan (**18**) proposed the name *Raiamas* as a 'substitute for *Bola* Günther, 1868, preoccupied by Hamilton' and designated *Cyprinus bola* Hamilton as the type of the genus. Evidently he was not aware of the fact that Day (**7**) had already restricted the use of *Opsarius* McClelland for *Bola* Günther. In his *Genera of Fishes* he (**19**) noted that *Opsarius* is 'apparently a synonym of *Barilius* Ham.' Chaudhuri (**5**), without looking properly into the contention of Jordan, revived the generic name *Bola* and erroneously regarded *C. bola* and *C. goha* as distinct species. Mukerji and I used the generic designation *Raiamas* in recording the 'Indian Trout' from the Dehra Dun hills, without looking into the past changes in the nomenclature of the species. If it be conceded that *Cyprinus bola*, with *C. goha* as a synonym, should be regarded generically different from other species of *Barilius* on account of its very wide mouth then its proper scientific title should be *Opsarius bola* (Hamilton), but the question whether *C. bola* is generically distinct from the other known species of *Barilius* still remains to be elucidated.

A glance at Day's figures of the various species of *Barilius* described in the *Fishes of India* (pls. cxlviii; cxlix; cli, fig. 2) shows that the extent of the mouth is a very variable character in this genus. In *B. guttatus* (Day) from Burma the cleft of the mouth is deep and extends for a considerable distance behind the eye. The suborbitals are also very broad, 'more especially the hindermost which is nearly behind the vertical from the posterior margin of the orbit, and almost covers the cheek.' In these respects the species agrees very closely with *B. bola* and was originally described under the generic designation *Opsarius* (**8**). In *B. tileo*, *B. gatensis*, *B. bakeri*, *B. modestus* and *B. vagra* the posterior extremity of the maxilla extends to beneath the middle of the orbit and the suborbital bones cover a considerable part of the cheek. In *B. bendilisis*, *B. barila*, *B. canarensis* and *B. barna* the posterior extremity of the maxilla reaches to below the anterior third of the orbit, while in the remaining species—*B. evezardi*, *B. shacra* and *B. radiolatus*—the maxilla just reaches the margin of the orbit. It is clear from the above that though no generic importance can be attached to the extent of the mouth, the condition in *B. guttatus* and *B. bola* is sufficiently characteristic to warrant their inclusion in a separate group within the genus *Barilius*. I, therefore, propose to call the 'Indian Trout' *Barilius* (*Opsarius*) *bola* Ham.

Systematic Position.

The genus *Barilius* belongs to the sub-family Rasborinae of the family Cyprinidae, usually known as Carps (Order: Ostariophysi; Sub-order: Cyprinoidea). In the fishes of this family the head and the body are usually compressed and, except in a few cases, the pectoral and the ventral fins are inserted along the sides and possess only one simple ray. There is no spine below the eye which has a free orbital margin or a gelatinous eyelid. The mouth is inferior or terminal; its upper border is formed by the premaxillaries only. There are never more than two pairs of barbels. The body is covered with scales and the lateral line is generally complete. The pharyngeal teeth are present in one, two or three series. The air-bladder is usually large and free in the abdominal cavity.

In the Rasborinae the abdominal surface is not compressed into a sharp edge. As a rule, the lower jaw is provided with a symphysial knob, fitting in an emargination of the upper jaw. The dorsal fin is without an osseous spine and is situated behind the ventrals. The lateral line abruptly bends downwards and, when complete, runs along the lower half of the tail.

The members of the genus *Barilius* are characterised by their compressed snout and anterior mouth. Moreover, they usually possess spots or vertical bars on the body. In the sub-genus *Opsarius*, as indicated above, the cleft of the mouth extends beyond the eye. Besides the 'Indian Trout', there is only one other species—*B.* (*Opsarius*) *guttatus* Day—which possesses this character; it is found in Burma and possesses 44-48 scales along the lateral line (*versus* 88-94 in *bola*).

Description and Distribution.

Barilius (Opsarius) bola Hamilton.

THE INDIAN TROUT.

Vernacular names.—Buggah (Orissa); *Korang* (Assam); *Bola* (Bengal); *Buggarah* (Hindi); *Goha* (Purniah Dist.); *Bhola Goalpara, Na-laida* (Mechi); *Gulabi Machli* or rose-speckled fish.

B. iii; D. 3/7-8; A. 3/10; P. 13; V. 9; C. 19; L. l. 88-94; L. tr. 12-15/9-11.

Barilius bola possesses the characteristic Trout-like form; its dorsal profile is scarcely arched, while its ventral profile is somewhat convex. The head and body are greatly compressed: the former is sharply pointed. The length of the head is contained from 4.3 to 4.6 times in the length without the caudal. The head is proportionately smaller in the younger individuals. The width of the head is considerably greater than the width of the body and is contained from 1.9 to 2.3 times in the length of the head; the height of the head is contained from 1.5 to 1.6 times in the same dimensions. The depth of the body is contained from 5.4 to 5.7 times in the total length and from 4.3 to 4.6 times in the length without the caudal. The caudal peduncle is well formed; its least height is contained from 1.5 to 1.9 times in its length; in smaller individuals it is proportionately deeper.

The eye is situated slightly below the level of the dorsal profile and entirely in the anterior half of the head. In adult specimens the mouth opening extends about 1½ diameters of the eye behind the posterior margin of the orbit. The eye is proportionately much larger in the younger individuals; its diameter is contained from 5 to 7 times in the length of the head, from 1.4 to 2.1 times in the length of the snout and from 1.1 to 1.9 times in the interorbital width. The interorbital space is more or less flat. In some adult specimens the snout and cheeks are covered with 'pearl-organs'[1] and there are also tubercles on the dorsal surface of the anterior rays of the pectoral fin in single rows. The lower jaw is also covered with sharply pointed tubercles. Such specimens agree in every respect with Blyth's description of *Leuciscus salmoides* (*vide supra*, p. 202), and in my opinion represent the males of the species. Sufficient material is, however, not available to elucidate these sex differences. The mouth is very wide and obliquely directed upwards. The upper jaw is longer than the lower and is deeply notched in the middle to receive a very prominent knob of the lower jaw. The suborbital ring of bones is very wide, especially the third which in adults is as wide as the distance between its hind border and that of the operculum. The barbels are altogether absent. The scales are very small. The lateral line is curved anteriorly and then it is continued to the lower half of the base of the caudal fin.

The dorsal fin commences somewhat behind the anterior origin of the ventral and its free edge is only slightly curved; its commencement is equidistant between the anterior margin of the orbit and the base of the caudal fin in young specimens while in the adults it is midway between the posterior margin of the orbit and the base of the caudal fin; it is considerably higher than long. The pectoral fin is almost as long as the head behind the eye and is separated from the ventral by a considerable distance; its outer rays are the longest, and there is a scaly appendage in its axil. The free border of the ventral fin is concave in the young specimens, while in the adult males three of the inner rays are somewhat produced so that they form a regular lobe; these elongated rays are probably used for clasping during copulation. The caudal fin is deeply forked with both the lobes equal and pointed.

In young individuals the colouration is much lighter than that of the adult. The back is greenish-gray and this is separated from the silvery portion below by a longitudinal golden stripe. The fins are yellow. The greenish-blue spots on the sides are oblong and their number in a specimen about 13 cm. in total length varies from 15 to 17. In between these spots, at a somewhat lower level, there are indications of a second series of spots. The middle portion of the lower lobe of the caudal as well as its posterior margin are grayish. With the growth of the fish the colours become much deeper and the yellow is replaced by orange. The spots become rounded and are irregularly distributed in many rows. In fully mature specimens they also occur on the preoperculum, the suborbital bones and the operculum. Day's description of the colouration of a fairly grown-up specimen is as follows:

---

[1] The term 'pearl organs' is used for the cornifications of the skin which take the form of small tubercles; these appear chiefly on the head of various Cyprinoid fishes at breeding time.

> 'Silvery with two or more vertical rows of bluish blotches along the sides, the upper being about twelve to twenty, and the lower intermediate; some spots also on the head. Lower half of the dorsal fin slightly gray. Caudal orange, stained with gray and black. Pectoral, ventral and anal orange, the colours being somewhat similar to those of a trout.'

A colour drawing of the species was published by Spence and Prater (**21**) based on the drawing and description by Day in his *Fishes of India*. The specimens, of which the drawings are reproduced here, were collected by me from the Song River near Lachhiwala in the Dehra Dun District. Unfortunately no notes on colouration were taken in the field, but the details have been filled from the original drawings of the species prepared by Hamilton over a century and a quarter ago. These drawings are beautifully prepared and well preserved. The author has left notes to the effect that he always had them coloured from living specimens.

Distribution.—Barilius bola is confined to the hilly parts of the Punjab, United Provinces, Bihar, Orissa, Bengal, Assam and Burma. Day records that it grows to about a foot in length, but mentions that 'one killed in Assam by Mr. Hannay is stated to have weighed 5 lbs.' Usually it weighs under 2 lbs.

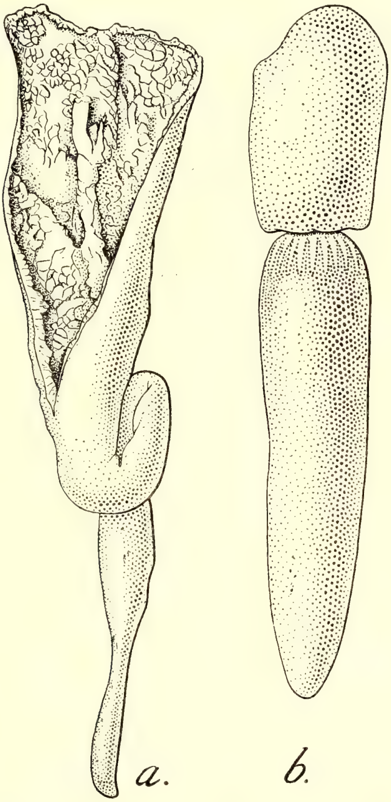
Measurements in millimetres.

Total length including caudal ...	107·0	130·0	285·0	286·0
Length of caudal ...	22·0	28·0	55·0	55·0
Depth of body ...	19·0	23·0	50·0	53·0
Width of body ...	10·0	11·0	24·0	29·0
Length of head ...	23·0	29·5	65·0	65·5
Width of head ...	12·0	15·0	28·5	32·0
Height of head at occiput ...	15·0	19·0	41·5	41·0
Length of snout ...	6·3	9·0	18·0	19·0
Interorbital width ...	5·0	8·0	17·0	18·0
Diameter of eye ...	4·5	6·0	9·3	9·3
Longest ray of dorsal ...	15·0	18·5	39·0	39·5
Longest ray of anal ...	13·0	17·0	34·0	35·0
Length of pectoral ...	15·0	19·0	41·0	41·0
Length of ventral ...	11·5	14·0	32·0	32·5
Length of caudal peduncle ...	14·0	17·0	41·0	41·0
Least height of caudal peduncle ...	9·0	10·0	22·0	22·0
Length of maxilla ...	13·0	17·0	37·0	37·0

BIONOMICS AND FISHING NOTES.

Thomas (**23**), on the authority of his several correspondents and personal experience, has given copious notes regarding the habits, habitat, occurrence in various localities and the type of rod and tackle required to deal with this fish. Those desirous of obtaining full details may consult this invaluable work in original.

The 'Indian Trout' is found in many rivers of Northern India where it lives in clear streams with rocky beds. Generally it prefers junctions[1] of streams or rapids at the head of pools. In such situations it preys on smaller fish and is thus very destructive to fisheries in general. I have also found remains of insects (of a dragon fly) inside the stomach of one of the individuals collected in the Song River. Its wide mouth and stream-lined body are admirably adapted for a predacious life and the form and structure of its alimentary canal (fig. 1*a*) leave no doubt that it is a highly carnivorous species. McClelland (**20**) noted:



Text-fig. 1.—Alimentary canal and air-bladder of *Barilius* (*Opsarius*) *bola* Ham. Nat. size. From a specimen about 11 in. in total length. *a*. Alimentary canal: anterior part of stomach is cut open to show the nature of its internal wall; *b*. Air-bladder.

> 'The stomach is equal to about half the entire length of animal, and the intestine from the stomach to the vent only about half the length of the

---

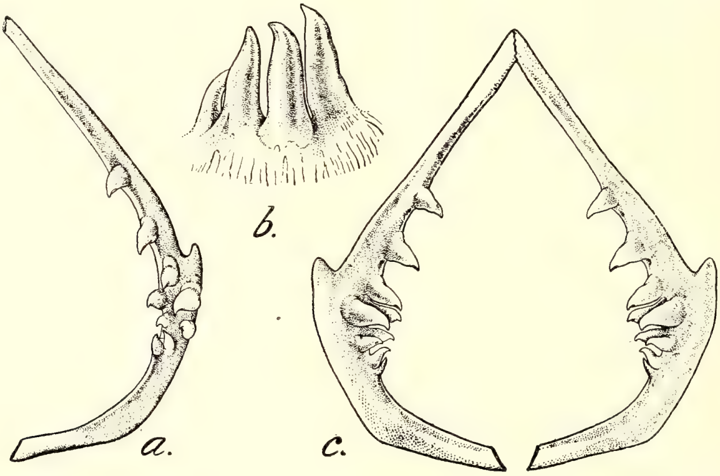
[1] The advantages of such a habitat were pointed out by me in the account of 'Fish of Chitral' (**16**).

stomach itself, and separated from that organ, which it rivals in capacity, merely by a stricture.

'The liver and other large glands whose functions are supposed to facilitate digestion are extremely small in this species, though it is possessed of an insatiable carnivorous appetite; nor have I found in Cyprinidae, in general, those glands bear any proportion to the size of the stomach, or the nature of the food in different species.'

The inner surface of the stomach is raised into folds running in various directions (fig. 1*a*) which help to increase the glandular area meant for the secretion of the gastric juice. The liver, though short in the anterior region, extends along the stomach as noted by McClelland in his general account of the genus *Opsarius*. This peculiar disposition of the liver, and also of the kidneys, which extend along the entire dorsal wall of the body cavity, is brought about by the compression of the body which has resulted in the great reduction of the space inside the body cavity. Moreover, *B. bola* possesses a large air-bladder (fig. 1*b*) which is long and narrow but extends throughout the length of the abdomen. This indicates the importance of the air-bladder in the economy of life of this species which has been sometimes observed to swim near the surface with a part of its head almost out of water.

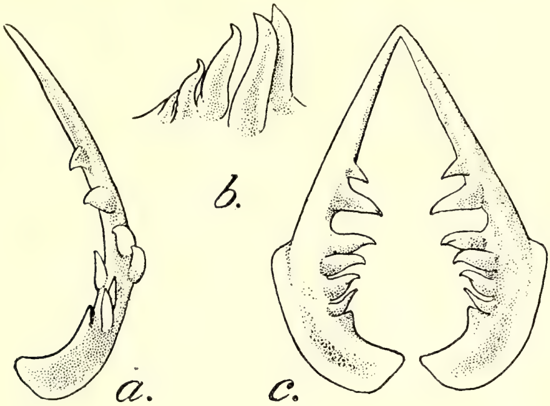
The pharyngeal teeth of *Barilius bola* (figs. 2 and 3) are sharp at the distal end and produced into a point; the distal portion is somewhat curved so that the form is blade-like. Such types of teeth are undoubtedly meant for tearing up prey or holding it firmly during ingestion. In the young specimens the teeth



Text-fig. 2.—Pharyngeal bones and teeth of an adult specimen of *Barilius* (*Opsarius*) *bola* Ham.

a. Pharyngeal bone and teeth from the inner side, ×2⅔; *b*. Some of the pharyngeal teeth magnified to show their form, ×4; *c*. Pharyngeal bones and teeth in their normal position, ×2⅔. From a specimen about 11 in. in length.

(fig. 3) are more slender and the outermost row contains only 4 teeth (4.3.1), while in the adult condition there are 5 teeth in the outermost row and the teeth are somewhat more massive.



Text-fig. 3.—Pharyngeal bones and teeth of a young specimen of *Barilius* (*Opsarius*) *bola* Ham.
a. Pharyngeal bone and teeth from the inner side, ×8; *b.* Some of the pharyngeal teeth magnified to show their form, ×12; *c.* Pharyngeal bones and teeth in their normal position, ×8. From a specimen 4·2 in. in length.

According to Day, 'It is a very game fish, takes the fly well, and is one of those termed *Rajah mas*, or "chief of the fishes" in the Assam rivers.' In the Dehra Dun hills another species of *Barilius*, *B. bendilisis* Hamilton, is used as a bait for the 'Indian Trout'.

The 'Indian Trout' is usually fished with a fly, a small spinning bait, or tiny spoon. 'A small fly with white wings, is, perhaps, best. On being hooked, it jumps repeatedly out of the water and rushes about furiously, fighting gamely to the last. The lightest ten-feet fly rod is recommended with extra fine gut casts.'[1]

So far as I am aware, no information is available regarding the breeding habits of the Indian Trout.

The Bombay Natural History Society very kindly made a grant towards the cost of illustrations and for this I have to offer my sincere thanks to the authorities of the Society.

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EXPLANATION OF PLATE.

Lateral view of a young and an adult specimen of the Indian Trout, *Barilius (Opsarius) bola* Hamilton. × $\frac{2}{3}$.

The specimens were collected from the Song River near Lachhiwala in the Debra Dun District, United Provinces.

(To be continued).

THE MONGOOSES OF BRITISH INDIA, INCLUDING CEYLON AND BURMA.

BY

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(*From the Zoological Department of the British Museum, Natural History*).

(*With* 2 *text-figures*).

INTRODUCTION.

Blanford assigned the Mongooses of these countries to eight distinct species. Wroughton, however, in his revision increased the number to nine. He followed Thomas in uniting *fulvescens* (=*flavidens*) with *fuscus*, giving it subspecific rank, but he resuscitated *nepalensis*, which Blanford quite correctly regarded as a synonym of *auropunctatus*, and he gave a new name, *lanka*, to the Ceylonese form of the so called common Indian Mongoose, although Blanford, again correctly, regarded the two as referable to the same species. Thomas and Wroughton, however, with the splendid material of Mongooses collected by the Mammal Survey in their hands were mainly interested in the local races, or subspecies, into which most of the genuine species proved to be divisible. In conjunction with Miss Ryley, they introduced a considerable number of new names for these minor subdivisions; but too little attention, if any, was paid to the frequently well marked variations in the coat and colour according to season, with the result that some of the alleged subspecies were based upon characters due to this phenomenon. In the two most recent works upon the Mongooses of these countries of the Oriental Region, namely Mr. W. W. A. Phillips's *Manual of the Mammals of Ceylon* and Mr. S. H. Prater's account in Part IV of 'The Wild Animals of the Indian Empire' [*J.B.N.H.S.*, xxxviii, Pt. II, pp. 149-55 (1936)], the authors very naturally adopted Thomas's and Wroughton's opinions.

The following account of these eastern Mongooses is based upon an examination of all the skins and skulls in the British Museum, including the valuable series, with full particulars regarding date, locality and sex, collected by the Survey. The net result is the admission of only six distinguishable species of Mongooses (*Herpestes*) and a reduction in the number of subspecies into which some of them are divisible. There are also a few changes in nomenclature. The reasons for these and for my dissent from some of the conclusions of my predecessors are fully given under their appropriate headings. As in other papers on British Indian Carnivora published in this *Journal* I have purposely put on record a large number of details connected with individual specimens obtained by the collectors who worked for the Mammal Survey of India. The vast number of specimens that was secured leaves the impression that Mongooses of one kind or another are the dominant Carnivores of British India. But the original home of the family was probably Africa where it is represented by several well defined genera, including *Herpestes*, which is also found in Spain. Generic names were introduced, principally by Gray, for most of the Indian species; but it seems preferable to retain them provisionally in *Herpestes*. These generic names are mentioned under their appropriate headings. Their typical species were selected by Thomas [*Proc. Zool. Soc.* (1882), p. 63].

Key to the British Indian Species based on external characters.

A. A conspicuous stripe on the side of the neck; tail about two-thirds the length of the head and body.

1. Neck-stripe black, extending from behind the ear and composed of soft underhair; hind foot naked to heel; tail-tip black; chin and forethroat dark; contour hairs typically extensively red at tip ... *vitticollis.*

2. Neck-stripe white, extending from corner of mouth and composed of coarse contour hairs; hind foot hairy below nearly down to the hallux; end of tail pale; chin and forethroat white; contour hairs whitish at tip ... ... *urva.*

B. No stripe on side of neck.

1. Size larger; contour hairs long, many banded, usually coarse; legs darker than body.

a. Tail about two-thirds the length of the head and body; about half the sole of the hind foot hairy in its upper part; contour hairs softer ... *fuscus.*

b. Tail longer, at most a little shorter than the head and body, sometimes longer; hind foot usually naked to the heel, at most a comparatively small area hairy in the upper part in winter.

¶ Tail tip from whitish to reddish ochreous ... *edwardsii.*

¶¶ Tail tip extensively black ... ... *smithii.*

2. Size smaller; contour hairs short, with a few bands, soft, sometimes silky; legs not appreciably darker than body ... ... *javanicus.*

Key to the Species based on skull characters.

A. Anterior chamber of bulla reduced, posterior large, subconical and prominently projecting inferiorly; first upper molar (m^1) with distinct cingulum; teeth generally more robust, less trenchant ... ... *vitticollis.*

B. Anterior chamber of bulla larger, posterior rounder, not so prominent inferiorly; no cingulum on m^1; teeth more trenchant.

1. Skull large and heavy and, as in *vitticollis*, with the sagittal and occipital crests weak so that the posterior portion of the upper surface is downcurved and the dorsal profile is never subhorizontal behind the orbits, sometimes evenly, though lightly convex ... ... *urva.*

2. Skull smaller, much less robust, actually and relatively narrower, the dorsal profile behind the orbits subhorizontal, generally slightly sinuous, the occipital and sagittal crests being well developed behind.

a. Posterior chamber of bulla larger than anterior and projecting to a lower level; skull larger.

¶ Frontal region not noticeably elevated, the postorbital dorsal area not depressed, the upper surface of the muzzle less steeply sloped	*fuscus.*
¶¶ Frontal region elevated, area behind it typically depressed, upper surface of muzzle more steeply sloped	*edwardsii* and *smithii.*
b. Chambers of the bulla approximately equal and projecting to about the same level; skull smaller	*javanicus.*

Herpestes edwardsii, Geoffroy.

For the bibliography and synonymy of this species see below, especially under the subspecific headings.

Distribution: N. India from Assam to the North-Western Frontier Provinces, thence westwards into Afghanistan, Baluchistan and Persia and southwards to Cape Comorin and Ceylon.

A medium-sized or tolerably large Mongoose with no stripe on the side of the neck; the tail long, at most a little shorter than the head and body, sometimes a little longer, with the hairs at its tip pallid to ochreous red, never black; the legs darker than the body; the contour hairs of the back harsh and long or longish and marked with many, generally about ten dark and light bands alternately arranged giving a speckled aspect to the pelage; the sole of the hind foot generally naked to the heel but in some cases at least the heel is covered with hair in winter.

The general colour is very variable, sometimes individually in the same locality and at the same time of year, frequently also seasonally and also racially, the variation depending on the tint of the bands in the contour hairs, the dark bands being either black or brown or even paler, when faded, both these tints being sometimes replaced by red to a varying extent; the pale bands also vary from white to buffy white; the colour is also affected by the extent of the individual bands, being lighter when the pale bands are wider than the dark and darker when they are narrower, and since the number of bands is the same whether the hairs are long or short and increase in length with their growth, specimens in the short-haired, new coat are more finely speckled than those in the long-haired, fully developed coat which is coarsely speckled; the fur or underwool which is always present but scanty or abundant according to the season or district also varies in tint from very dark olive grey, often yellowish or red, to nearly white especially when seasonally faded.

These features of the pelage apply to some other species as well as to *edwardsii*.

The skull of the adult has the forehead more or less swollen so that the summit of the muzzle is somewhat steeply sloped, the dorsal area behind the orbits is depressed and rises posteriorly towards the occiput where the sagittal and occipital crests are strongly developed, the dorsal profile being horizontal with a sinuous curvature; the posterior chamber of the bulla is roundish, larger than the anterior and projecting to a lower level.

Much confusion is connected with the name of this Mungoose. It was cited as *Herpestes mungo* by Blanford and later as *Mungos mungo* by Wroughton. But J. A. Allen (*Bull. Amer. Mus. Nat. Hist.* 47, p. 161, 1924) showed that *Mungos mungo* Gmelin is the correct title for a generically distinct African Mungoose and adopted *nyula* as the name of the common Indian species. Thomas and Wroughton, however, accepting Allen's determination of *Mungos mungo,* chose for the Indian species the name *Herpestes edwardsii* Geoffroy based upon the description and figure by G. Edwards of a living specimen of the Indian Mongoose he saw in London. Thomas's decision on this point should, I think, be accepted. He, however, assigned the name *edwardsii* to the Mongoose from Bengal, which Wroughton regarded as typical *Mungos mungo.* But Edwards's figure and description do not agree with any Bengal skins I have seen. They indicate a much darker animal, agreeing better with the South Indian Mongoose Wroughton named *ellioti,* for which Thomas substituted *carnaticus,* than with any other Indian race; and since Edwards's specimen is quite as likely to have been exported from Madras as from Bengal, I propose to fix *edwardsii* on that race with *ellioti* and *carnaticus* as synonyms. This leaves the name *nyula* Hodgson available for the Bengal form.

Another name, not uncommonly applied in the past to this Mongoose and recently resuscitated for it by Bechthold (*Zeitschr. Saug.*, xi, p. 149, 1936), is *griseus* Geoffroy (*Descr. de l'Egypte*, ii, p. 139, 1812) proposed for a specimen described and figured by Buffon (*Hist. Nat.*, iii, p. 174, *Suppl.*, pl. 27, 1776) as 'Le Nems' and said to have been sent to him from the interior of Africa. Buffon's description agrees with the common Indian Mongoose and, presumably for that reason, Geoffroy cited the East Indies as the locality for his *Ichneumon griseus*. There seems to be no other justification for Geoffroy's alteration of Buffon's record more than thirty years later. But *griseus* is in any case inadmissible for the species, whatever it be, because it was preoccupied twenty years earlier by *nems* Kerr [*Anim. King*, p. 160 (1792)] based on the same Mongoose mentioned in Smellie's translation of Buffon, vii, p. 221 (1791), where the eastern parts of Africa are cited as its locality. On the available evidence *nems*, and its synonym *griseus*, cannot be applied to this Indian species.

The subspecies into which this species have been divided are by no means always easy to define or determine. Not only do they completely intergrade, but specimens from the centre of the geographical area of one race may be indistinguishable from specimens from the geographical area of another. Nevertheless I have seen no skins in Northern India like those of Travancore or Ceylon nor skins of the Ceylonese style in North India.

On the average they may be distinguished as follows:—

A. Winter coat with the contour hairs longer and more coarsely speckled, the pale speckling more in evidence, with the general hue lighter, red on head, etc. more prevalent.
    1. General colour a trifle darker with less tendency to erythrism (North and North Central India) ... *nyula.*
    2. General colour a trifle lighter, erythrism more prevalent (Valley of the Indus, N.-W. deserts, Baluchistan) ... ... *ferrugineus.*

B. Winter coat shorter, more finely speckled, pale speckling not dominant over dark, general hue darker with red everywhere less in evidence, sometimes absent.
    1. Speckling on the average coarser (S. India) ... *edwardsii.*
    2. Speckling on the average finer (Ceylon) ... ... *lanka.*

Herpestes edwardsii nyula, Hodgs.

Mangusta (*Herpestes*) *nyula,* Hodgson, *Journ., As. Soc. Beng.,* v, p. 236 (1836).

Mongos mungo mungo, Wroughton, *Journ., Bomb. Nat. Hist. Soc.,* xxiv, p. 52 (1915). (Not of Gmelin).[1]

Herpestes edwardsii edwardsii, Thomas and Wroughton, *Journ., Bomb. Nat. Hist. Soc.,* xxvii, p. 547 (1921).

Mungos mungo moerens, Wroughton, *Journ., Bomb. Nat. Hist. Soc.,* xxiv, p. 52 (1915).

Locality of the type of *nyula*, Nepal; of *moerens,* Nimar.

Distribution: Northern India from Nepal to Assam north of the Ganges and from Cutch to Bengal south of the river.

Winter coat composed of long, rather harsh contour hairs, and up to 50 mm. or more in length, and plenty of wool, the general speckling of the body and tail coarse; colour vary variable seasonally, the shorter new coat prevalently silvery, with contrasted black and white speckling, the black fading to brown and the white soiled in the older coat, but even in the new coat the speckling may be brown and buffy or yellowish; hairs of the underside with dark speckling or fading to uniformly pale; typically some red on the muzzle, cheeks and ears; sometimes a little on the crown and nape; the wool varying from dark olivaceous grey to soiled white; the legs dark or rufous brown and grizzled.

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[1] Wroughton's very inadequate diagnosis of this race as having the underfur comparatively very sparse and the hairs on the lower back 40 mm. long was evidently based upon a specimen or specimens from Bengal in summer coat. He could not have examined Hodgson's skins of *nyula*, regarded by him as a synonym of *mungo*. At least one of them has plentiful underwool and the rump hairs about 50 mm.

The following notes show the individual variations in different districts.

Nepal. Hodgson recorded *nyula* as the common Mongoose of the Nepalese lowlands and North Behar, but his description of the type does not fit any of the six undated skins he sent home. The colour was 'mixed rich, red brown and hoary yellow', the long harsh hairs having from 10 to 12 rings of alternate brown and yellow, the ears, face, and limbs being redder and the underside pale yellow. This was apparently an aberrant reddish specimen indistinguishable from some specimens of the following race, *ferrugineus*. One of his skins in the British Museum (No. 43.1.12.17) may be the type, but the dark speckling is only brown, pale drabby, with the head and nape rather brighter. His series varies as follows:—The contour hairs on the rump range from about 40 to 50 mm. and the wool is copious or very scanty. The dark speckling varies from blackish and blackish brown to darker or paler brown, the pale from silvery to dull grey or drab and the wool from yellowish olive to pale drab or soiled whitish. The lower side is drabby or greyish, sometimes indistinctly dark speckled; the head has some red at least on the muzzle, cheeks and ears, sometimes on the crown and nape as well; the tail is like the body, with the tip, when present, soiled whitish; the legs are dark brown or rufous brown and grizzled, one skin showing abundance of rusty red above the hocks.

The colour of these skins of Hodgson's has probably deteriorated with age; but the following from places to the east of Nepal and north of the Ganges are not racially separable from them.

Darbhanga, 150 ft. Several skins from Bahgownie (*Crump*), July 25 to October 10, show interesting individual variations. The coat is from about 30 to 40 mm. according to the earlier or later date, the wool being similarly negligible in amount or fairly plentiful; the speckling is contrasted black and white in the new short coat, duller and less contrasted in the older longer coat; the wool varies from olivaceous to yellowish and frequently shows through the contour hairs, affecting the coloration of the dorsal surface.

Haldibari, S. of Sikhim, 150 to 200 ft., April 13 to 20. One specimen is a trifle more silvery than the palest Nepal skin. Another is intermediate between the palest and the brownest Nepal skins. The wool in both is pale grey.

Jalpaiguri, N. of Kuch Behar, April 18. A skin resembling the second from Haldibari in having pale brown speckling.

Goalpara in Assam, S. of the Brahmaputra, August. A ♀ with the coat 34 mm., the colour finely speckled with black, brown and white and the wool olive grey exactly matches one of the Darbhanga skins dated August 25.

In two districts to the west of Nepal and north of the Ganges, namely from Kumaon, 1,100 to 2,500 ft., November and December, and from Pilibhit in Rohilkund, 800 ft., March, several specimens were collected and are very much alike, the general colour being speckled black and white, as in the first described specimen from Haldibari; the wool is pale buffish white in the Kumaon skins but whiter in those from Rohilkund. These skins were identified by Wroughton as *pallens* (see below p. 217) and quite correctly according to his erroneous conception of his *mungo*, i.e. *nyula*.

From two localities south of the Ganges in Western Bengal, namely Hazaribagh, 600 to 1,800 ft., April 18 to June 26 and from Daltonganj, 600 ft., March 24 to April 1, Crump sent several skins which call for no special comment, except that one from Daltonganj has a good deal of red on the head and some on the nape as in the brownest of the Nepal skins.

Gwalior. A good series of skins from several localities and dated from June to the end of November exhibits great variation in colour although not the ferruginous phase, there being at most a little red on the muzzle. In the late autumn coat (October and November) the contour hairs, about 55 mm., are speckled black or blackish and clear white, those of the underside being ticked with black; the feet are dark with hardly any brown tinge and the tail-tip is ochreous or flavous. In the summer coat, June and July, the contour hairs of the dorsal side are faded, speckled very pale brown and soiled white, there is no dark speckling below and the legs are much paler and browner; the underwool bleaches from dark olive grey to dirty whitish.

Most of the skins Wroughton assigned to *moerens* are in fresh unfaded coat, with the black and white speckling sharply contrasted, and resemble the darkest of the skins from Darbhanga (August) and Gwalior (October).

Cutch, 200 to 500 ft., July 10 to August 15. Nine skins in new short coat are mostly speckled black and white, one being browner in hue, the wool is scanty and varies from smoke grey to greyish ochreous, the legs from dark to reddish brown speckled with grey; the head has a little red.

Kathiawar, 200 to 2,500 ft., October 6 to December 1. Eleven skins have the coat fuller and longer in accordance with the later season, but are generally similar to the Cutch series, varying to a certain extent in the clearness of the white speckling, in the wool which is darker or lighter olivaceous grey and in the amount of red on the head and limbs.

Nimar. Two skins, including the type of *moerens* from Ganoor, 1,000 ft., December 22 and 23, resemble the Kathiawar lot but have the wool ashy grey, the type itself having some red on the nape. One from Asigarh, 1,500 ft., November 3, has the wool much darker, olivaceous.

Berar, Ellichpar, 1,500 ft., May 17, a ♂ closely resembles the type from Nimar but has more reddish brown on the muzzle and legs and the wool slightly yellowish grey. Considering the date, it is surprising that this skin shows no sign of coat change.

E. Khandesh, one from Shendurni, 900 ft., March 30, is speckled black and white like the preceding and has the wool olivaceous grey, and another from Parola, 8,800 ft., March 13, has begun to bleach, the dark speckling being brown and the wool pale grey.

Hoshangabad, Sohagpur, 1,000 ft. Five skins, April 10 to 13, vary greatly in colour. One is speckled black and white, like the preceding lots, with the legs very dark brown. A second is much paler with broader white bands, some red on the back and the wool whitish. A third has the dark speckling faded mostly to pale brown and not strongly contrasted, the hind feet rufous, the wool drabby and the belly hairs not speckled as they are in the first. The contour hairs on the rump vary from about 30 to nearly 50 mm. This series showing seasonal change in colour connects typical *moerens* with the Nepalese series.

FLESH MEASUREMENTS AND WEIGHTS OF SOME SPECIMENS OF *nyula*.

—		Head and Body	Tail	Hind-foot	Weight lbs.
Cooch Behar, Haldibari.	ad. ♂	15⅗	14⅖	3	2¾
Darbangha	... ad. ♂	15⅗	14⅘	3 –	...
Daltonganj	... ad. ♂	16⅖	15⅕	3⅕	...
Kumaon, Ramnagar	... ad. ♂	17	16	3⅕	3½
,, ,,	... ad. ♂	16⅖	14⅕	3⅕	4
Rohilkund, Pilibhit	... ad. ♂	16	14⅕	3	3
Gwalior, Guna	... ad. ♂	17⅖	15⅘	3½	...
,, Ghatigaon	... ad. ♂	17	14⅘	3 +	3¾
Hoshangabad	... ad. ♂	17⅕	15⅖	3 +	3½
Kathiawar	... ad. ♂	16⅘	14⅕	3 –	3¼
Cutch, Nokania	... ad. ♂	15⅘	15⅕	3 +	3
Daltonganj	... ad. ♀	14⅖	14⅗	3 –	...
Kumaon, Naini Tal	... ad. ♀	15⅘	13⅘	2⅘	2
,, Ramnagar	... ad. ♀	15⅖	15⅖	2⅘	...
Rohilkund, Pilibhit	... ad. ♀	15⅕	13⅕	2⅘	2
Gwalior, Ghatigaon	... ad. ♀	15⅘	14	2⅘	2¼
Nima (*mœrens* type)	... ad. ♀	15⅗	14⅖	3 –	2¾
Kathiawar	... ad. ♀	15⅘	15⅕	3	2½
Cutch, Nokania	... ad. ♀	14⅗	13	2⅗	...

SKULL MEASUREMENTS OF *H. edwardsii nyula.*

LOCALITY AND SEX		Cond. Bas. Length	Zygom. Width	Post. Orb. Width	Int. Orb. Width	Max. Width	Mand. Length	pm^4	m_1
Nepal (Hodgson)	... ad. ♂	78	42	13	15	15	...	8 × 6	...
Darbangha	... ad. ♂	77	38	11	14	14	...	7 × 5	...
Hazaribagh	... ad. ♂	84	42	11	16	15	56	7½ × 5	7
Kumaon	... ad. ♂	82	42	14	16	15	53	7½ × 5½	7
Bahraich, U.P.	... ad. ♂	77	38	14	15	14	50	7 × 5	7
Daltonganj	... ad. ♂	82	40	13	16	15	52	8 × 5	7
Gwalior	... ad. ♂	82	44	13	16	16	...	7½ × 5	...
,,	... ad. ♂	79	41	12	14	14	52	7 × 4½	6
Berars	... ad. ♂	81	45	13	15	15½	...	7½ × 6	...
Kathiawar	... ad. ♂	83	...	14	16	16	53	8 × 6	7
Cutch	... ad. ♂	80	41	12	15	15	51	8 × 6	7
,,	... ad. ♂	77	42	13	16	15	50	7½ × 5½	7
Nepal (Hodgson)	... ad. ♀	71	36	12	12	12	46	7 × 5½	7¾
Daltonganj	... ad. ♀	75	38	11	14	13	49	7 × 5	7
Gwalior	... ad. ♀	79	41	12	15	13	52	8 × 5	7
,,	... ad. ♀	75	38	11	14	13	49	7 × 5	7
Nimar (*moerens* type)	... ad. ♀	80	38	12	15	14	51	7 × 5	7–
Cutch	... ad. ♀	73	36½	12	13½	13	46	8 × 6	7

The specimens in this table from Nimar, Berars, Kathiawar and Cutch were referred by Wroughton to *moerens*.

Male skulls are on the average larger than female skulls, although they overlap in size.

Herpestes edwardsii ferrugineus, Blanf.

Herpestes ferrugineus, Blanford, *Proc. Zool. Soc.* (1874), p. 661, pl. 81.

Herpestes andersoni, Murray, *Vert. Zool. of Sind*, p. 34 (1884).

Mungos pallens, Ryley, *Journ., Bomb. Nat. Hist. Soc.*, xxii, p. 660 (1914).

Mungos ferrugineus and *pallens,* Wroughton, *Journ., Bomb. Nat. Hist. Soc.*, xxiv, pp. 51-4 (1915).

Herpestes griseus montanus, Bechthold, *Zeitschr. Säug.*, xi, p. 149 (1936).

Locality of the type of *ferrugineus*, Larkhana, Sind; of *andersoni*, Kotree, Sind; of *pallens,* Palanpur, N. Gujerat; of *montanus*, Hazara.

Distribution: Mainly the desert districts of N.-W. India in the valley of the Indus and Sutlej and to the east in Rajputana and to the west into Baluchistan and Persia.

Distinguished on the average from *nyula* by its paler, whiter colour, with less black speckling in the contour hairs, its paler wool and by a greater tendency for the replacement of the dark speckling by red or rich ochreous, the replacement being sometimes complete as in the type of *ferrugineus*, sometimes partial as in *andersoni*, whereas in the normal form of the race represented by the type of *pallens* there is no red on the body, although the red of the head and limbs is typically more pronounced and contrasted than in *nyula*.

The type of *H. ferrugineus,* Blanford, from Larkhana, Sind, was red all over, all the normal black speckling of the coat being replaced by rusty red, the tail becoming progressively redder towards the tip. Blanford at first regarded this as representing a valid species, but subsequent examination of intermediates induced him finally to regard it as a 'variety' of the common Indian Mongoose.

Murray recorded apparently similarly red specimens as *ferrugineus* from Kotree and Karachi in Sind, and at the same time described as *H. andersoni* a partially red specimen from Kotree. This had the contour hairs of the back banded black and white, with a ferruginous apical or subapical tip, the tail hairs mostly white with extensively reddened tips; the forehead ferruginous and rather darker red than the chin, throat and the rest of the under side; the feet rufous brown with black toes; the wool ferruginous at the summit, yellowish-white at the back.

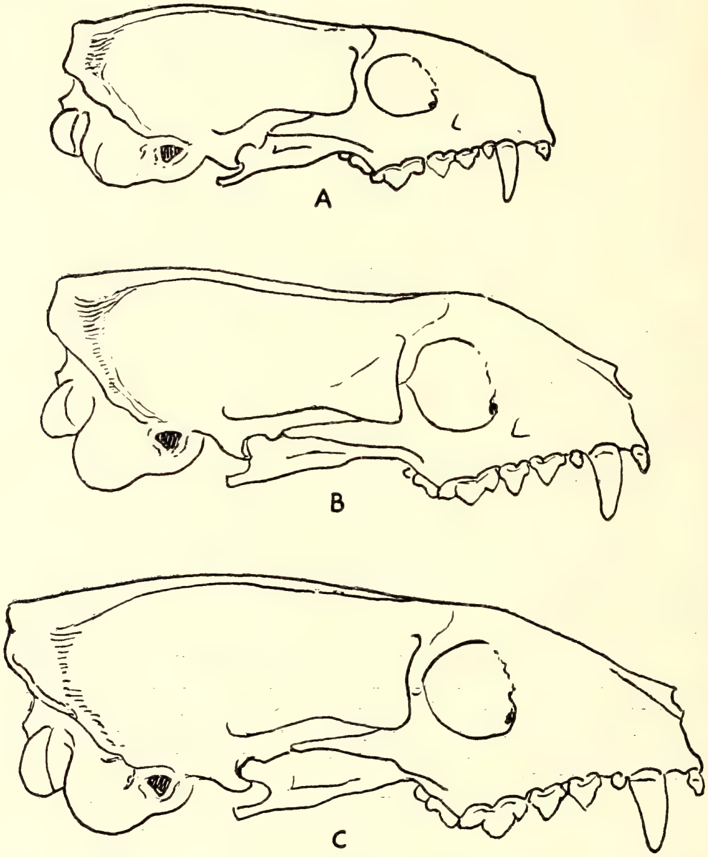

Fig. 1.—A. Skull of adult ♂ of *Herpestes javanicus pallipes* from Kandahar.
B. Skull of adult ♂ of *Herpestes edwardsii nyula* from Nepal.
C. Skull of adult ♂ of *Herpestes fuscus fuscus* from S. Coorg.

There are no specimens in the British Museum like the type of *ferrugineus* and Wroughton's diagnosis of *ferrugineus*, which he regarded as a race, was based on specimens evidently closely resembling *andersoni*, although not red below or in the wool. The occurrence of typical *ferrugineus* and of *andersoni* at Kotree suggests that they merely represent colour phases of one and the same form. Also the occurrence of specimens evidently closely resembling *andersoni* in the same locality as specimens indistinguishable from *pallens* justifies in my opinion the view that *ferrugineus* and *andersoni* are red or reddish mutants of *pallens*, the normal form. Unfortunately the name *ferrugineus*, given to a hitherto unique specimen exhibiting the extreme phase of erythrism, has to be adopted for this race, as the earliest proposed.

The following account of skins from different districts shows the range of variation in colour and other characters:—

Sind. In four skins from Khairpur (Prater), April 8 to 15, the dark speckling of the coat varies from black to very pale brown, the wool from drab to palish grey, the tail tip from reddish ochreous to flavous, the head being dull brownish with only a little red on the muzzle. Two from Sukkur, March 16 and 27, on the contrary, have the head, nape and tail-tip reddish ochreous and a faint reddish cast over the back. These two evidently come near the type of *andersoni* in tint. Nearer still and possibly one of Murray's specimens of the latter is a skin from the Karachi Museum, labelled Sind and dated December, which has the dorsal surface speckled black and white with a reddish cast, the head, neck and tail-tip reddish ochreous, and the wool yellowish-drabby. As mentioned below one of the skins from Kangra closely matches the Sukkur skins except that the tail-tip is flavous.

An aberrant ♀ skin from Tata, west of the Indus in S. Sind (McCann), October 23, with the speckling contrasted black and white, a little red on the head but none elsewhere, the feet dark brown, grizzled, and the wool olivaceous grey, exactly matches skins from Cutch, July and August, identified by Wroughton as *moerens*.

Gujerat, Palanpur, 150 ft. (Crump). An adult ♂ (type of *pallens*), March 21, has the coat thinnish but 52 mm. long on the rump, the general colour of the back coarsely speckled white and brown, but with some black on the back, the head reddish, the tail-tip flavous, the wool greyish white, the legs reddish brown and the underside white. An adult ♀ from Danta, 100 ft., January 25, has the coat 45 mm. the general tint with blacker speckling, as if less faded in accordance with the different date; but the fore paws, the hind feet below the hock, the inside of the thighs, and the abdomen are albino.

Rajputana. Seven skins from several localities, dated January to June, differ greatly in coat and colour according to season. A ♀ from Jodhpur, February 22, the darkest of the series, has the coat 50 mm., the general colour brownish, fitting in with the Nepalese series of *nyula*, the wool plentiful, pale drab in hue with a yellowish suffusion in places, the drab matching the wool of a Nepal skin with the palest wool. Of three skins from Sambhar two are sharply contrasted, one, January 25, being speckled silver and black, a second, April 27, pale brown and soiled white, a third, March 5, intermediate between them, the wool being soiled white in all. Six from Mt. Abu, 4,300 ft., May 19 to June 5, have the coat short and harsh, the white speckling dominant, the dark from blackish to drabby brown with little, if any, light coloured wool but the head, especially the nose, and the legs, especially the hind, reddish and contrasted with the pale body; the tail-tip pallid.

Kohat, south of Peshwar, N.-W. F., 2,000-2.700 ft. A ♀, October 25, is the reddest and the most like *andersoni* of all the skins in the British Museum. The coat, 53 mm., has plenty of wool greyish and drabby at the base with a buff tinge at the summit; the head and cheeks are rusty and slightly grizzled, the neck is a little less red, but that tint is traceable in all the dorsal contour hairs where it more or less displaces their black tips; the tail is rather heavily red especially at the tip and the legs are grizzled rufous brown. A second ♀, March 9, has the coat 59 mm., the wool the same, but the head, body and tail are much paler and less red, with the white of the contour hairs more manifest; the feet, however, are the same. These two skins suggest that the difference between them is due to the gradual bleaching of the winter coat between the end of October and the beginning of March. In all probability the March skin would have lost all its red before the coat was shed. The skin from Sind (Karachi Museum), December, is nearly intermediate between the two.

Chaklala, Rawalpindi, in the Upper Punjab (Stockley). Two skins, July 6 and 13, closely resemble the skins from Mt. Abu in Rajputana, both in the condition of the coat and in colour, but one skin has some red on the nape; the scanty wool is soiled yellowish in both skins.

Hazara between Peshawar, N.-W. F., and Kashmir (not Hazara in Afghanistan). An ad. ♂ skin, undated but in full winter coat with the contour hairs about 55 mm. and abundance of underwool; the general colour is pale, the contour hairs in accordance with their length being broadly banded whitish and blackish brown with the tips from the nape to the rump and on parts of the tail slightly reddened, but the red cast hardly visible unless the coat is raised; the wool is yellowish or yellowish grey, becoming whitish on the rump; the tail tip is whitish, the legs rusty brown and grizzled, the head reddish and the under side uniformly drabby yellow. This skin, the type of *Herpestes griseus montanus,* obviously represents the winter phase of the two summer skins from Rawalpindi. It is very like the March skin from Kohat but not so red anywhere, and is very similar to the type of *pallens* except that the bands on the tail are blacker and there is a slight reddish cast on the body.

Chamba, 3,000-3,300 ft. (Wells), January 22 to 25. Four skins collected at Changa vary considerably in colour. The coat is full, ranging from about 45 to over 50 mm. in length. A ♂ has the speckling normally coarse, black and whitish, with no red on the dark brown head except on the cheeks and ears, the wool pale greyish and the legs dark brown, speckled, with no appreciable red tinge, and the tail tip flavous. A ♀ is darker, with the pale speckling finer and buffy or yellowish in tint, the head brownish red but no red on the body, the wool dark olivaceous grey, the legs very dark with the toes nearly black and the tail-tip dark ochreous. Another ♀ has the head and nape, especially the head, rusty brown, there is a reddish wash on the back, above the hock and on the base of the tail, the tip of the latter being flavous; the fur is mostly drabby grey, the fore legs reddish brown, with hardly any pale speckling, from above the wrist, with some white hairs on the toes, the hind the same but more speckled and without trace of albinism. This specimen almost exactly matches the skin from Kohat, March 9, except that the tail-tip is flavous.

Kangra, 2,000-7,000 ft. (Wells). About 20 skins, mostly labelled Kangra, 2,000 ft., March 20 to April 2, with a few more from Dhamtal, 2,000 ft., November 11; Guggal, 4,000 ft., February 10; Gopalpur, 7,000 ft., March 9; and Sanyala, 5,000 ft., April 18. The coat is full, from about 45 to 55 mm., the general colour is on the whole tolerably uniform and grey, coarsely speckled with white and black or brownish black; the head is normally reddish and frequently there is a reddish cast on the nape, back and the root of the tail, the tip of the tail being always flavous; the wool is pale grey or drabby grey, often noticeably darker on the fore back than on the hind back and rump and the legs are brown, nearly always with a rusty tinge. Two skins differ somewhat from the average. The first is a single adult ♀ from Dhamtal, November 11, which has the wool uniformly ochreous buff all over the upper side, suggesting that the pale wool in the March skins may be faded. In the colour of its wool this Dhamtal skin seems to approach the type of *andersoni* from Kotree, Sind. The second is an adult ♂ from Sanyala, April 18, which has the dorsal coloration generally much lighter than in the others, with the head and nape, especially the head bright ochreous red and the legs ochreous and unspeckled, the toes of the fore foot being albino. This skin closely resembles examples from Sukkur in Sind and elsewhere, which fall into the *andersoni*-phase of *ferrugineus,* except that the tail-tip is flavous not ochreous. The skins with the reddish wash also approach that phase, but they differ very little from the redder of the two examples of *nyula* from Daltonganj, whereas those which have only the normal amount of red on the head and none elsewhere are practically indistinguishable from some examples assigned to *nyula.* I refer the series to *ferrugineus* because of the considerable percentage of specimens exhibiting a tendency to redness. They may, however, be considered intermediate between *nyula* and the red phase of *ferrugineus* as the skins from Kumaon and Rohilkund are intermediate between *nyula* and the pale or *pallens* phase of *ferrugineus.*

Baluchistan. Seven skins (J. E. B. Hotson) collected at various localities and dates exhibit variations similar to those of the other districts considered. One from Mand, 900 ft., December, one from Gumajgi, 500 ft., 50 miles west of Turbat, December, one from Panjgur, 3,200 ft., January, closely match the skins from Kumaon and Rohilkund. Another from Geh, on the Perso-Baluchi border, January, is also like them except that the wool is ashy grey at the base, buffy at the summit. Seasonal change is illustrated by a second skin from Panjgur, May 26, which has the coat thin and harsh, the general colour dull, the black speckling faded to pale brown, the white speckling soiled, the scanty wool drabby grey showing under the hair; and one from Jebri, 147 miles south south-west of Kelat, 3,775 ft., August 31, also in poor coat, has the speckling blurred and faded and with the brownish grey wool giving a general tawny hue to the pelage. None of the above described skins shows any reddish tinge except a trifle on the head; but one from Qasrgand on the Perso-Baluchi border, 1,710 ft., December 29, is of the ferruginous *andersoni* type closely matching the October skin from Kohat but not quite so red on the back although redder than the Sind specimen from the Karachi Museum.

The dimensions in the following table suggest that specimens from Kangra and Chamba are larger, sex for sex, in length of head and body than those from Sind, Rajputana etc. and also than those assigned to *nyula*. But they were measured by a different 'hand'; and since the tails and hind feet, in which there is less likelihood of discrepant results, are not longer, it seems wiser to suspend judgment on the point and to refrain from indicating by a new racial name the apparent difference, especially as it is unsatisfactorily supported by the size of the skulls which at most are a mere trifle longer in condylobasal length. Additional observations on the subject are given below under the notes on the skulls.

To the measurements of the British Indian specimens in this table are added those of an adult ♂ from Shiraz, Persia, collected by Sir J. E. B. Hotson. attesting general agreement with specimens from Baluchistan, Sind and Gujerat. It belongs to the *pallens* phase, showing no special erythrism.

Only a few weights were recorded. The two ♂ specimens from Mt. Abu, Rajputana, were respectively 3 and 2¾ lbs., the ♂ from Palanpur, Gujerat, the type of *pallens*, was 3¼ and the ♀ from Danta, Gujerat 2 lbs.

FLESH MEASUREMENTS IN ENGLISH INCHES OF SOME SKINS ASSIGNED TO *ferrugineus*.

		Head and Body	Tail	Hind foot
Kangra (largest)	... ad. ♂	21⅕	14	3⅕
,, (smallest)	... ad. ♂	18⅘	14	3—
,, Average of 9	... ad. ♂	19⅗	...	...
Chamba	... ad. ♂	20⅘	15⅖	2⅘
Rajputana, Mt. Abu	... ad. ♂	17⅕	15⅕	3½
,, ,, ,,	... ad. ♂	16	13¼	3½
Gujerat (*pallens* type)	... ad. ♂	15⅕	16—	3—
Sind, Sukkur	... ad. ♂	16⅖	15⅘	3½
,, Khairpur	... ad. ♂	15⅖	13⅖	3—
Baluchistan, Mand	... ad. ♂	15⅕	14⅗	3+
Persia, Shiraz	... ad. ♂	15⅕	15⅖	3
Kangra (largest)	... ad. ♀	18⅖	15⅕	3—
,, (smallest)	... ad. ♀	14⅕	14⅖	2⅘—
,, Average of 10	... ad. ♀	16⅘	...	...
Chamba	... ad. ♀	16⅘	14	2⅘
,,	... ad. ♀	15⅖	15	2⅗—
Kohat, N.W.F.P.	... ad. ♀	14	14¾	2⅘
Sind, Sukkur	... ad. ♀	14⅘	15¼	3—
,, Khairpur	... ad. ♀	14⅗	14⅕	2⅘
,, Tata	... ad. ♀	14⅘	12⅕	3—
Gujerat, Danta	... ad. ♀	15	14⅕	2⅘
Baluchistan, Qasrqand	ad. ♀	14	14¾	2⅘

Comparing skull-measurements with flesh-measurements there are one or two points to be noted. The two measured ♂ skulls from Kangra, 83 and 77 mm. respectively in condylo-basal length, agree very closely with the two ♂ skulls from Mt. Abu, in S. Rajputana. But the head and body of the skin of the larger Kangra skull is indicated as over 3 in. longer than the skin of the larger Mt. Abu skull and the smaller Kangra skull, which is 2 mm. shorter than the smaller Mt. Abu skull, belongs to a skin of which the recorded head and body length is very nearly 3 in. longer than in the Mt. Abu specimen. These recorded differences cast further doubts on the trustworthiness of the head and body lengths of the Kangra specimens. Also there is by no means always correspondence in size between skulls and head and body measurements. The skulls of the two Kangra specimens measuring 21⅕ and 18⅘ in. respectively are alike 77 mm. in condylobasal length whereas two specimens measuring respectively 20⅖ and 20 in. have skulls 83 mm. long.

The largest of the Kangra skulls marked ♀, with a length of 81 mm. has all the characters of a ♂. It has the same number as the ♀ skin measuring 18⅖ in. in head and body. But one of the ♂ skins has a ♀ skull assigned to it. Possibly they got mixed. At all events the rest of the ♀ Kangra skulls range from 76 to 72 mm. in length, the average of 8 being 74¾ mm.

SKULL MEASUREMENTS OF *ferrugineus*.

LOCALITY AND SEX	Cond. bas. Length	Zygom. Width	Post Orb. Width	Int. Orb. Width	Max. Width	Mand. Length	pm^4	m_1
Kangra (largest) ... ad. ♂	83	44–	13	16½	15	55	8 × 5½	7
,, (smallest) ... ad. ♂	77	39	11	14	14	49	7 × 5	6½
,, Average of 6 ... ad. ♂	81	...	...	...	...	...	...	...
Chamba ... ad. ♂	(81±)	42	12	16	15	54	7½ × 5½	7
Hazara (type of *montanus*) ... ad. ♂	(80±)	40	13	13½	14½	52	8 × 6	7
Rajputana, Mt. Abu. ... ad. ♂	82	43½	12	17	14	53	...	...
,, ,, ,, ... ad. ♂	79	41	13	15	13	51	7½ 5	7–
,, Sambhar ... ad. ♂	78	40	13–	14	14	51	8 × 5½	7½
,, ,, ... ad. ♂	74	39	12	15	14	48	7½ × 5	6½
Sind, Khairpur ... ad. ♂	79	40	12	15½	14½	51	8 × 6	7½
,, Sukkur ... ad. ♂	78	41	12½	15	14½	52	7½ × 5	7
Gujerat, Palanpur (*pallens* type) ... ad. ♂	79	41	12	15	15–	51	8+ × 5+	7
Baluchistan, Panjgur ... ad. ♂	75	40	15	15	15	50	8– × 5	7
Persia, Shiraz ... ad. ♂	78	39½	13	15	14	51	8 × 5	7
Kangra (largest) ... ad. ♀	81	44	13½	16+	16+	54	8 × 5½	7
,, (smallest) ... ad. ♀	72	36	12–	14–	13–	48	7 × 5	7
,, Average of 9 ... ad. ♀	75½	...	...	...	...	...	...	...
Chamba ... ad. ♀	77	37	13	13½	13	51–	8 × 5	7
,, .. ad. ♀	73	38	13	13	13½	47	7½ × 5	6½
Kohat, N.W.F. Prov. ... ad. ♀	75	37	15	14½	13	48–	8 × 6	7
Rajputana, Jodhpur ... ad. ♀	73	38	12–	14–	13	...	7 × 5	...
,, Sambhar ... ad. ♀	71	35	11	12	12	45–	7 × 5	6½
Sind, (Karachi Mus.) ... ad. ♀	75	39	12	14	13	...	7½ × 5	...
,, Khairpur ... ad. ♀	74	37½	10	14	13	49	7 × 5	7–
,, ,, ... ad. ♀	72	36	11	13	13	46+	7+ × 5	6½

Herpestes edwardsii edwardsii, Geoffroy.

'*The Indian Mongoose*', Edwards, *Nat. Hist. Birds*, iv, p. 199 (1751).

Herpestes edwardsii, Geoffroy, *Descr. de l'Egypte*, ii, p. 139 (1812), (not of Thomas and Wroughton).

Herpestes pondiceriana, Gervais, *Voy. de la Bonite*, i, p. 32 (1841).

Mungos mungo ellioti, Wroughton, *Journ.*, *Bomb. Nat. Hist. Soc.*, xxiv, pp. 51 and 53 (1914), (not *ellioti*, Blyth).

Herpestes edwardsii carnaticus, Thomas, *Journ.*, *Bomb. Nat. Hist. Soc.*, xxviii, p. 23 (1921).

Locality of the type of *edwardsii*, 'East Indies'; of *pondiceriana*,[1] Pondicherry; of *ellioti* Wrought. and *carnaticus*, Dharwar.

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[1] This name was apparently intended for a specimen from Pondicherry mentioned by Cuvier and Geoffroy (*Hist. Nat. Mamm.* 1819) as La Mangouste.

Distribution: Southern India, Western and Eastern Ghats, south of the Narbada River, from Ratnagiri to Travancore and Madura.

Distinguished on the average in its unfaded coat from *nyula* by its darker general tint owing to the blackish brown bands in the hairs being more extensive than the whitish or buffy white bands. The coat also is shorter, about 40 mm. or a little over; the wool is dark, usually olive grey but often with a strong ochreous tinge; there is typically some red on the head and ears, but this is variable in amount; the legs are darker or lighter brown and grizzled, the tail tip is pale ochreous and the under side is usually, but not always, speckled with black or brown.

This description applies generally to a large number of skins from the following western localities:—Ratnagiri, January 21 to 28; Dharwar, 2,000-2,500 ft., October 30 to February 18; N. Kanara, 1,900 ft., January; N. Coorg, 3,555 ft., January 16 to February 15; S. Coorg, 2,000 ft., January 10 to February 6; Seringapatam, 2,340 ft., October 12 to 28; Cochin, 1,500 ft., June 8; Nilgiri Hills, 3,500 ft., undated; Trivandrum in Travancore, August 4 to September 2. Of these the Travancore skins are practically indistinguishable from those of the Ceylon race, *lanka*.

Skins from the eastern districts of S. India are more variable. Of two, undated, ticketed Madras (Jerdon), one is like those above described, the other has the pale speckling more silvery. Similarly paler is one from the Palkonda Hills, S. Cuddapah, 1,000 ft., August 17; one from the Shevaroy Hills, 4,500 ft., May 17; some from Tirthamalai, Salem, 3,000 ft., June 22 to July 9; and one undated, from Kombu, S. Coimbatore; but one from the northern slopes of the Palni Hills, 3,000 ft., December 15, is a dull dark, short coated skin, and of two from High Wavy Mountain in Madura, near the Travancore border, May 28 to 30, one is like the Salem skins, the other is paler with a yellowish wash, broader pale bands in the contour hairs, and altogether is more like *nyula* than typical *edwardsii*.

The Survey also secured through Baptista many additional specimens, from Kurnool, May, the Palkonda Hills, 1,500 ft., July; the Vontimitta Range, 325 ft., August; the Dharmapuri Range, N. Salem, 850 ft., August and October; and the Denkanikota Range, 3,062 ft., October. These skins are all pale and silvery very like pale skins of *nyula* but with slightly finer speckling and almost always less red on the head and legs, although one from the Palkonda Hills is as red on the head as typical *nyula*.

Judging from a specimen in the British Museum collected by Dr. Cantor in Wellesley Province and identified by him as *Herpestes griseus*, it is this Southern Indian race that occurs in the Malay Peninsula and not the 'Bengal' race (*nyula*) as supposed by Blyth and Jerdon. The first record from Malacca was made by Cuvier and Geoffroy [*Hist. Nat. Mamm.* pl. 189 (1819)] who figured and described a specimen as 'La Mangouste' and later (*Suppl. Table Gén.*, p. 3 (1842)] identified it as *Herpestes mungo*. This specimen was described as *Herpestes frederici* by Desmarest [*Dict. Sci. Nat.*, xxix, p. 60 (1823)]. Subsequently it was named *H. malaccensis* by Fischer [*Syn. Mamm.*, p. 164 (1829)], who erroneously, and to the confusion of some authors, assigned *malaccensis* to Cuvier. But clearly *malaccensis* is a synonym of *frederici* and both are synonyms of *edwardsii* according to my identification of the last. The point is of some importance in nomenclature because, as stated above, Blyth and, following him, Jerdon used *malaccensis* for an Indian Mongoose; and comparatively recently Kloss when citing a specimen from Larut, nr. Perak, as *Mungos mungos* added that if distinct the Malayan animal would take the name *malaccensis* [*Journ., Fed. Mal. St. Mus.*, vii, p. 123 (1917)]. Kloss's ♀ specimen measured 15 in. in the head and body, but had an exceptionally short tail, only 11½ in., almost exactly the same as in one of Pillay's specimens of *edwardsii* from Travancore and in some specimens of *lanka* from Ceylon; but Cuvier's specimen, the type of *frederici* (*malaccensis*) was 11 in. in head and body, 12 in. in the tail. No doubt it was young and probably the terminal hairs were included in the tail which would make it, without the hairs, about as long as the head and body.

This Mongoose is believed to have been imported into Malaya from India. This seems probable since there is no record of *edwardsii* from Burma.

Flesh measurements of *H. edwardsii edwardsii* are as follows:—

—		Head and body	Tail	Hind-foot
Dharwar (*carnaticus* type)	... ad. ♂	$19\frac{1}{5}$	$16\frac{2}{5}$	$3\frac{3}{5}$
,, ,,	... ad. ♂	$17\frac{1}{5}$	16	3
S. Coorg	... ad. ♂	17	14	3-
Cochin	... ad. ♂	$18\frac{1}{2}$	$15\frac{3}{4}$	$2\frac{3}{4}$
Trivandrum	... ad. ♂	$15\frac{2}{5}$	$13\frac{1}{2}$	$2\frac{4}{5}$
Kurnool	... ad. ♂	$17\frac{3}{5}$	$16\frac{1}{5}$	$3\frac{1}{4}$
,,	... ad. ♂	$16\frac{1}{3}$	$16\frac{3}{5}$	$3\frac{1}{8}$
Palkonda Hills	... ad. ♂	$17\frac{1}{2}$	$14\frac{4}{5}$	$3\frac{1}{2}$
,, ,,	... ad. ♂	$15\frac{1}{5}$	14	$3\frac{1}{5}$
Vontimitta Range	... ad. ♂	$17\frac{1}{5}$	$15\frac{1}{5}$	$3\frac{1}{4}$
Shevaroy Hills, Salem	... ad. ♂	$18\frac{4}{5}$	$17\frac{3}{5}$	$3\frac{1}{5}$
Madura	... ad. ♀	$18\frac{1}{5}$	16	3-
Ratnagiri	... ad. ♀	$15\frac{2}{5}$	$13\frac{1}{5}$	$2\frac{3}{5}$
Dharwar	... ad. ♀	$15\frac{3}{5}$	$15\frac{2}{5}$	$2\frac{4}{5}$
N. Coorg	... ad. ♀	$15\frac{1}{2}$	13	$2\frac{4}{5}$
Trivandrum	... ad. ♀	$14\frac{3}{5}$	$13\frac{1}{5}$	$2\frac{4}{5}$
Kurnool	... ad. ♀	16	$14\frac{4}{5}$	$2\frac{4}{5}$
,,	... ad. ♀	$15\frac{1}{5}$	$14\frac{4}{5}$	3
Palkonda Hills	... ad. ♀	16	14	3
,,	... ad. ♀	$14\frac{2}{5}$	14	3-
Vontimitta Range	... ad. ♀	16	$14\frac{2}{5}$	3
Dharmapuri Range, Salem	... ad. ♀	$15\frac{3}{5}$	$14\frac{4}{5}$	3

The weight of adult ♂ specimens is usually from 3 to 4 lbs., of ♀ specimens from 2 to $2\frac{3}{4}$ lbs.; but the ♂ from Madura was 6 lbs. and the ♀ from Ratnagiri 4 lbs.

Herpestes edwardsii lanka, Wrought.

Herpestes griseus, Kelaart, *Prodr. Faun. Zeyl.*, p. 41 (1852), (not of Geoffroy).

Mungos lanka, Wroughton, *Journ.*, *Bomb. Nat. Hist. Soc.*, xxiv, p. 53 (1915).

Herpestes lanka, Phillips, *Man. Mamm. Ceylon,* p. 177 (1935).

Locality of type: Cheddikulam, N.P., Ceylon.

Distribution: Ceylon, 'confined to the low country dry zone' up to 500 ft. (Phillips).

Very closely resembling the South Indian race, but distinguished by having the contour hairs shorter and the speckling finer, the two features going together, and in being on the average less red on the head and feet and less richly tinted in the wool when the coat is unfaded.

Wroughton gave full specific rank to this Ceylonese representative of *edwardsii* because of the alleged absence of intergradation between it and the Indian specimens. Nevertheless the S. Indian race is obviously intermediate between the Ceylonese and the more northern Indian races, as might be expected. The two features Wroughton relied on for the status he assigned to *lanka* were the very fine grizzling and the absence of ferruginous tint from the face and feet. These characters hold good in the four skins in the British Museum, namely the type from Cheddikulum, N.P., November 12; two from Tammanewa, N.C.P., May 3 and 9; and one, undated, received from the Colombo Museum. These are very much alike, varying very slightly in the tint of the speckling, the practical identity in colour and coat between the November and May skins suggesting that the seasonal differences are slight. The coat in these specimens is only up to about 30 mm.; the wool is scanty and drabby grey in hue, without the ochreous tinge common in the S. Indian race, and there is no trace of red on the head, ears, feet or elsewhere. But sometimes there is no red in even dark coloured S. Indian skins, e.g. some from Travancore, and it has apparently faded out in some summer skins from the Eastern Ghats. Phillips, moreover, in his description of *lanka* says that the feet and head have a slightly reddish tinge. With regard to the redness all that can be said of *lanka* is that it is on the average less red than the S. Indian race.

The following flesh-measurements in English inches were recorded by Phillips:—

—	Head and body	Tail	Hind-foot
ad. ♂: ...	18 +	13⅓	3–
ad. ♀: ...	15⅕	12	2⅗
av 4 ♀: ...	14	10⅘	2½

The type of the race, a young adult ♂, is a little smaller than the largest ♀ in the British Museum from Tammanewa which agrees closely with Phillips's largest ♀.

Skull Measurements of *H. edwardsii edwardsii* and of *H. edwardsii lanka.*

Locality and Sex	Cond. Bas. Length	Zygom. Width	Post Orb. Width	Int. Orb. Width	Max. Width	Mand. Length	pm^4	m_1
edwardsii								
Dharwar ad. ♂	81	42	14 –	15	15	52	8 – × 6 –	7
,, (*carnaticus* type) ad. ♂	80	43	13½	16 –	15 +	52	8 × 6	7
S. Coorg ad. ♂	80	41	14	15	15	51	7½ × 5½	7
,, ad. ♂	79	41	11	14½	14	53	7 × 5½	7
Cochin yg. ad. ♂	80	40	14	15	15	51	7 × 4	7
Kurnool ad. ♂	86	44	13	16	16	55	8 × 5½	7 +
,, ad. ♂	80	42	11	15	15	53	8 × 5	7 +
Palkonda Hills ad. ♂	81	39	13	15	15	52	7 × 5	7
,, ,, ad. ♂	77	39	12	14	15	50	7 × 5½	7
Vontimitta Range ad. ♂	78	40	12	15	14	51	7 × 5	7
Salem ad. ♂	80	41	11	15	15	52	7 × 5	7 –
Dharwar ad. ♀	76	36	12	13	12	49	7 × 5	7
,, ad. ♀	73	37	12	14 –	13	46	7 × 4½	6
S. Coorg ad. ♀	77	36	11	13	12	50	7 × 5	7 –
Seringapatam ad. ♀	75	40	12	14½	14	...	7 × 5	...
Kurnool ad. ♀	76	39	11	14	14	48	7 × 5	7
Palkonda Hills ad ♀	74	38	12 –	14	13	50	7 – × 4½	6
,, ,, ad. ♀	72	36	11	14	13	48	7 × 5	6½
,, ,, ad. ♀	68	35	13	13	12½	44	7 × 5	6½
Vontimitta Range ad ♀	76	37	13	14	13	49	7½ × 5	7
lanka								
Cheddikulam (type) yg. ad. ♂	79	40	13 –	14½	15	51	8 × 5½	7
,, (type) ad. ♀	72 +	35	11½	13½	13	46	8 × 5	7

Herpestes smithii, Gray.

For bibliography and synonymy see under the subspecies.

Distribution: Central and Southern India; Ceylon.

Very closely related to *H. edwardsii* but distinguished by its slightly larger size, the black-tipped tail, generally darker colour and generally more pronounced tendency to erythrism, although never so red as in the typical *ferrugineus* mutant of that species. In the slightly larger skull the occipital and sagittal crests are at least on the average less strongly developed.

Since I have seen no intermediates between *smithii* and *edwardsii* in the colour of the tail-tip, I adopt the prevalent view that they represent distinct species. But the colour of the tail-tip varies from black to pale individually in some African Mongooses. Hence in this case it may possibly indicate that *smithii*, being a jungle-form, is a 'habitat-mutant' of *edwardsii*.

In his revision of this species Thomas (*Journ., Bomb. Nat. Hist. Soc.*, xxviii, p. 23 (1921)] admitted five races:[1]—(1) the typical form, *smithii*, with *ellioti* and *torquatus* as synonyms, ranging from Hoshangabad to the Nilgiri Hills in Western India; (2) *jerdoni*, with *monticolus* as a synonym, from the Eastern Ghats; (3) *canens* from Mt. Abu in S.-W. Rajputana and Hazaribagh; (4) *rusanus* from Sambhar in Rajputana; (5) *zeylanius*, a substitute for the inadmissible name *rubiginosus*[2] adopted by Kelaart, from Ceylon. A few specimens from the Eastern Ghats have been received at the Museum since Thomas wrote, but I do not think his conclusions with regard to the Indian forms were justified by the material he had in his hands. On the available evidence it seems to me that the difference in colouration between his *smithii*, *canens* and *jerdoni* are due to seasonal changes in the coat; and his race *rusanus* was based upon a single specimen with a rather small skull. Hence I regard all the described Indian forms as representing a single race. I adopt, however, his name for Ceylonese specimens, which, on the average, appear to differ from the continental form.

The two races, here provisionally admitted, may be distinguished as follows:—

A. Tail longer, sometimes longer than head and body; more grey and less red on the average in the general colour (India) ... ... *smithii*.

B. Tail shorter, never so long as head and body; more red and less grey on the average in the general colour (Ceylon) ... ... *zeylanius*.

Herpestes smithii smithii, Gray.

Herpestes smithii, Gray, *Charlesw. Mag. Nat. Hist.*, i, p. 578 (1837); id. *Proc. Zool. Soc.* (1851), p. 131, pl. 30.

Calictis smithii, Gray, *Proc. Zool. Soc.* (1864), p. 565.

Herpestes ellioti, Blyth, *Journ., As. Soc. Beng.*, xx, p. 162 (1851).

Herpestes jerdonii, Gray, *Proc. Zool. Soc.* (1864), p. 550.

Herpestes torquatus (Elliot MS.), Kelaart, *Prodr. Faun. Zeyl.*, p. 40 (1852); Jerdon, *Mamm. Ind.*, p. 136 (1867).

Herpestes monticolus, Jerdon, *Mamm. Ind.*, p. 135 (1867).

Herpestes smithii rusanus and *canens*, Thomas, *Journ., Bomb. Nat. Hist. Soc.*, xxviii, p. 25 (1921).

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[1] He set aside *thysanurus*, applied by Wagner in 1839 to a Mongoose, with a black-tipped tail, said to have come from Kashmir, because no Mongoose with that character has since been recorded north of Rajputana. Wagner's record must nevertheless be borne in mind [*Münch., Gel. Anz.*, ix, p. 440 (1839) and *Säug., Suppl.*, ii, p. 301 (1841)].

[2] This name was given by Wagner to a specimen of *vitticollis* from the 'East Indies'. Both Kelaart and Blanford overlooked Wagner's statement, detected by Thomas, that the neck has a black mark on each side.

Locality of type of *smithii* unknown; of *ellioti*, the Carnatic; of *jerdonii*, 'Madras'; of *torquatus*, 'S. India'; of *monticolus*, inland from Nellore; of *rusanus*, Sambhar, Rajputana; of *canens*, Mt. Abu, Rajputana.

Distribution: Central and Southern India from Rajputana, eastward to Bengal, and southwards through the Eastern and Western Ghats.

The type of *smithii* Gray has no definite locality, date or flesh-measurements, but there is no good reason to dissent from Thomas's decision that it came from somewhere near Bombay. It is no doubt an early winter skin, the contour hairs on the rump being about 53 mm. long and there is abundance of dark brownish under wool. The general colour is dark with black and greyish white speckling and a reddish cast traceable in the hairs of the upper side, particularly on the head, neck and between the shoulders; the fore leg is dark reddish brown, speckled and the hind leg is brighter red.

Satara (S. H. Prater). An adult ♂ collected at Mehda, January 11, is a very close match of the type in every respect and justifies Thomas's allocation of the latter; but a second ♂ skin from Mehda, January 13, differs in having the pale speckling of the back buffy with no appreciable red cast. A third, adult ♂ from Patan, December 11, is darker than the type, with buffy grey speckling and no appreciable red in the hairs.

Poona (P. H. Gosse). An adult ♂ from Khandala, 2,500 ft., April 14, has the coat a little longer than in the Satara skins, about 60 mm., but the under wool scantier than in them and in the type and the pale speckling is clearer whitish, especially strongly contrasted with the skin from Patan, but there is no red cast except towards the head and the legs are even darker than in the Patan skin. The later date of this skin suggests that the under wool is moulting and the pale speckling bleaching. It very closely resembles the skin from Kurnool in the Eastern Ghats referred to below.

Rajputana, Sambhar (Hume). The type of *rusanus* Thos., an ad. ♂, January 13, in winter coat, is indistinguishable in colour and coat from the Satara skins as Thomas stated; but two ad. ♂ from Mt. Abu (Crump), including the type of *canens* Thos., collected June 2 and 3, differ in having the coat harsh and thin with little or no underwool, the general colour paler and greyer, with the pale speckling bleached white, and no red cast, although there is, as usual, some ochreous before the black tail-tip. These skins closely resemble the skin from Salem in the Eastern Ghats mentioned below.

Hoshangabad, 2,500 ft. (Crump), an ad. ♂, March 9, in winter coat, closely resembles the skins from Sambhar and Satara; and a ♀ skin from Hazaribagh (Crump), May 2, in summer coat, is like the Mt. Abu skins but has some red on the head and nape and is more like the Salem skin.

Skins from the Eastern Ghats vary like those described above.

Hills inland of Nellore. The ♂ lectotype of *jerdoni* Gray (=*monticolus* Jerdon) is a soiled skin, formerly exhibited, with a thin, harsh, dead coat and no appreciable underwool. There is a little red on the muzzle and head, the merest trace on the neck but none elsewhere. A ♀ with the same history is a better skin, but the coat is thin with no wool, the general hue being grey with blackish brown speckling, and a little red on the head and muzzle and some yellowish or buff above the hock and close to the black tail-tip. A third old skin labelled 'Madras' is very similar to the preceding two. It was on the evidence of these three skins that Thomas separated *jerdoni* from typical *smithii*.

A series of summer skins collected by Baptista in the Palkonda Hills, 1,500 and 1,600 ft., in June and July and in the Vontimitta Range, 325 ft., August 8 to 11, are topotypes of *jerdoni* since these hills are inland of Nellore. The coat is long from about 50 to 55 mm. but, in accordance with the season, has at most only a little underwool. The general colours of the back may be tolerably clear grey or may show a paler or richer yellow cast representing apparently the red of some winter skins but bleached. One from Kondagorlapenta in the Palkonda Hills, July 17, closely matches the skin from the Shevaroy Hills described below except that the red behind the shoulders of the latter is replaced by ochreous. Another skin from Dasarladoddi, Palkonda Hills, June 26, has no red or yellow behind the shoulders. At Kurnool in Cuddapah Baptista collected two skins, one May 2, closely matching the skin from Salem, April 23, described below; the other April 27 is more iron-grey than the preceding, being speckled black and silvery grey with a faint buffish wash on the back and very little red in front.

Shevaroy Hills (W. M. Daly). An unsexed, undated specimen with a full long coat, the contour hairs over 60 mm. and the tolerably abundant olivaceous wool 20 mm. General colour darker than in the preceding skins from the Eastern Ghats owing to the more intense black speckling, the red tint conspicuous on the head, neck, down the middle line of the back and increasing in amount and extent on the rump and outside of the thighs, also a good deal of it on the hind leg above and below the hock and on the fore leg from the elbow nearly to the wrist. Although this skin was in the Museum when Thomas revised *H. smithii*, he did not refer to it. It entirely negatives the distinction he drew between skins from the Western and Eastern Ghats. It obviously belongs to the same form as the type of *smithii* and the examples from Satara and its difference from the previously described skin from the Eastern Ghats is due to the coat being fresh and unfaded.

Salem, a little south of the Shevaroy Hills. A skin from Karumbapatti (Baptista), April 23, has the black speckling as in the Shevaroy skin and some red on the head and neck, but is not red elsewhere, showing a yellowish cast behind the neck on the upper side indicating incipience of bleaching as in some of the topotypes of *jerdoni*.

The flesh measurements in English inches and the weights of some specimens are as follows:—

——		Head and body.	Tail.	Hind foot.	Weight lbs.
Mt. Abu (*canens* type)	... ad. ♂	$17\frac{4}{5}$	$16\frac{2}{5}$	$3\frac{2}{5}$	4
,,	... ad. ♂	17	$17\frac{3}{5}$	$3\frac{1}{5}$	$3\frac{3}{4}$
Hoshangabad	... ad. ♂	$16\frac{4}{5}$	$16\frac{2}{5}$	$3\frac{2}{5}$	$3\frac{1}{2}$
Satara, Mehda	... ad. ♂	$18\frac{1}{2}$	$17\frac{4}{5}$	$3\frac{2}{5}$	6
,, Patan	... ad. ♂	17 +	$15\frac{2}{5}$	3 +	6
Poona, Khandala	... ad. ♂	$16\frac{1}{5}$	$15\frac{1}{5}$	$3\frac{2}{5}$	...
Kurnool, Diguvametta	... ad. ♂	$27\frac{4}{5}$	15	$3\frac{1}{5}$	...
,, ,,	... ad. ♂	16	$16\frac{3}{5}$	$3\frac{2}{5}$	$2\frac{1}{2}$
Palkonda Hills	... ad. ♂	$17\frac{1}{5}$	$16\frac{4}{5}$	$3\frac{2}{5}$	$4\frac{1}{4}$
Vontimitta Range	... ad. ♂	18	$18\frac{3}{5}$	$3\frac{2}{5}$	4
,, ,,	... ad. ♂	$17\frac{1}{5}$	$18\frac{3}{5}$	$3\frac{2}{5}$	$3\frac{1}{2}$
Hazaribagh, Bengal	... ad. ♀	$15\frac{4}{5}$	16	3 +	...
Palkonda Hills	... ad. ♀	$17\frac{1}{5}$	$15\frac{4}{5}$	$3\frac{1}{5}$	$3\frac{1}{2}$

This table shows that the tail in this race is about as long as the head and body. It may be as much as about one inch longer or two inches shorter.

Herpestes smithii zeylanius, Thos.

Herpestes rubiginosus, Kelaart, *Prodr. Faun. Zeyl.*, p. 43 (1852). [Not *Crossarchus* (=*Herpestes*) *rubiginosus* Wagner.]

Herpestes smithi, Blanford, *Mamm. Brit. Ind.*, p. 126 (1888), (in part).

Herpestes smithii zeylanius, Thomas, *Journ., Bomb. Nat. Hist. Soc.*, xxviii, p. 23 (1921); Phillips, *Man. Mamm. Ceyl.*, p. 188 (1935), (misquoted as *zeylanicus*).

Locality of the type of *zeylanius*: Mankeni, E.P., Ceylon.

Distribution: Ceylon.

Rather doubtfully distinguishable from the typical continental Indian form by being a little darker on the average, never so grey as the greyest skins of the latter and the reddest a little redder, but some skins both 'grey' and 'red' practically indistinguishable from Indian skins. Also the tail seems to be relatively a little shorter.[1]

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[1] Neither the flesh measurements nor the skulls bear out Thomas's statement that this race is larger than typical *smithii* from Western India.

To the following list of the flesh measurements in English inches and weights of some specimens in the British Museum, I have added particulars of the dimensions recorded by Phillips.

——		Head and body	Tail	Hind-foot	Weight lbs.
Phillips's largest	ad. ♂	18 +	14½	3⅖	4¾
Wellegalli S. P.	ad. ♂	17⅖	15⅖	3⅕	4¼
Mankeni, E. P.	ad. ♂	17⅕	15	3	3¼
Matugama, W. P.	ad. ♂	16⅘	13⅕	3 +	—
Phillips's Aver. of 8	ad. ♂	16½	12½	3 +	3¾
,, largest	ad. ♀	16⅗	14⅗	3⅕	2¾
Ranna, S. P.	ad. ♀	16⅕	13⅕	3 +	—
Mankeni, E.P.	ad. ♀	15⅘	12⅘	3 —	3
Kala Oya, N. W. P.	ad. ♀	14⅘	13⅕	3 +	2¾
Phillips Aver. of 2	ad. ♀	15½	13 +	3 +	2¾

Although the head and body are about the same length as in typical *smithii,* the tail is on the average shorter, and is always shorter than the head and body, nearly 4 in. in some cases. This also applies to several sub-adult additional specimens collected by E. W. Mayor which are not included in the table.

SKULL MEASUREMENTS OF *H. smithii smithii* AND *H. smithii zeylanius.*

NAME, LOCALITY AND SEX		Cond. Bas. Length	Zygom. Width	Post. Orb. Width	Int. Orb. Width	Max. Width	Mand. Length	pm^4	m_1
smithii									
Satara, Mehda	ad. ♂	90	45	13	17½	17	60 –	8 × 6	7
Mt. Abu, Rajput. (*canens* type)	ad. ♂	88	46	15	19	18	57	8 × –	...
Satara, Patan	ad. ♂	86	45	13	16½	17	56	9 × 6	8 –
Palkonda Hills	ad. ♂	86	45	14	17	16	57½	8 × 5	7
Poona, Khandala	ad. ♂	84	45	17	17	16½	56 –	8 × 5½	7
Vontimitta Range just	ad. ♂	83	40	14	17	16	53	9 × 5	7½
Sambhar, Rajput. (*rusanus* type)	ad. ♂	82	44 –	11	15	16	53½	8 × 5	7
Palkonda Hills	ad. ♀	86	46	14	17	16	56	8 × 6	7
Hazaribagh	ad. ♀	81	42	15	16	16	52	7½ × 5	7
Nilgiri Hills	ad. ♀	80	43	12	16	16	53	8 × 6	7
zeylanius									
Mankeni (type)	ad. ♂	89	49	15	19	19	59	9 × 6	8 –
Matugama	ad. ♂	86	45	15	17	16	56	8½ × 5	8 –
Kala Oya	ad. ♀	81	42	12	15	15	53	9 × 5	7½
Mankeni	ad. ♀	78	42	15	16	...	51	8 × 5½	7

In these tables the skulls are enlisted to show the range in condylobasal length, regardless of geographical distribution. It will be noticed that the difference between the skulls of the type of *canens* and of *rusanus*, upon which Thomas relied for distinguishing the two alleged races is exactly the same as the difference between the two ♂ skulls of *H. edwardsii edwardsii* from Kurnool entered on the previous table (p. 225). It also shows that the skulls of the S. Indian *smithii* and the Ceylonese *zeylanius* are on the average noticeably a little larger than the skulls of *H. edwardsii edwardsii* and of *H. edwardsii lanka* which occur in the same areas respectively.

Herpestes smithii is the type of the genus *Calictis*, Gray [*Proc. Zool. Soc.* (1864), p. 564].

Herpestes fuscus, Waterhouse.

For bibliography and synonymy see under subspecific headings.

Distribution: S. India and Ceylon.

Size about the same on the average as *edwardsii* and *smithii* but the tail relatively considerably shorter, only about two-thirds the length of the head and body, the contour hairs less harsh and the upper half or third of the sole of the hind foot clothed with hair throughout the year. General colour very variable according to the subspecies, ranging from blackish brown with the dark bands in the contour hairs extensive and the white very narrow in the typical Indian race, to nearly uniformly ochreous or sandy with the dark bands reduced to fine, comparatively indistinct speckling in two of the Ceylonese races.

In its general form and the shape of the teeth, the skull is very like that of *edwardsii* and *smithii*, but it is typically less inflated in the frontal region so that the upper surface of the muzzle is a little less steeply sloped and may be slightly concave, the anterior tympanic portion of the bulla is smaller and the external crest a little better developed.

Analytical Key to the subspecies.

A. On the average a little larger and more uniformly dark brown above and especially below; the tip of the tail not lighter than the rest (S. India) ... ... *fuscus.*

B. On the average smaller and paler or brighter in hue, not so brown especially below; tip of the tail paler than the rest (Ceylon).
  1. General colour darker, dark speckling conspicuous on the back, flanks and tail.
    a. Slightly smaller and less red ... ... *flavidens.*
    b. Slightly larger and redder ... ... *rubidior.*
  2. General colour not so dark, the dark speckling not so conspicuous on the back, obsolete on the flanks and tail.
    a. Darker and redder, dark speckling on back blackish and more conspicuous ... ... *maccarthiae.*
    b. Paler, straw-coloured, dorsal speckling brown and faint ... ... *siccatus.*

Herpestes fuscus fuscus, Waterhouse.

Herpestes fuscus, Waterhouse, *Proc. Zool. Soc.* (1858), p. 55; Jerdon, *Mamm. Ind.*, p. 136 (1867); Anderson, *Anat. Zool. Res. Yunnan*, p. 184, pl. 8, figs. 1-2 (skull), (1875); Blanford, *Mamm. Brit. Ind.*, p. 127 (1888); and of subsequent authors.

Locality of the type: India.

Distribution: S. India, typically in the hills from 3,000 to nearly 6,000 ft.

Slightly larger on the average than the Ceylonese races, with a rather longer, fuller coat, the contour hairs of the rump from about 40 to 60 mm., and on the whole a little darker and less bright in colour, the general hue dark brown or blackish above, relieved by the fine buff or buff-grey speckling, the contour hairs with a small black tip and a narrow pale penultimate band and below the latter typically two very extensive black bands separated by a very narrow greyish one, these black bands always much wider than the pale, although the proportion varies individually to a certain extent; the wool olive brown at the summit, darker at the base; there is no red in the pelage, the head and tail being coloured approximately like the back, although the pale bands of the tail, the tip of which is like the rest, are often greyer and more extensive; the under side brownish, a little paler than the upper and not so speckled.

The following notes show the variations in the skins in the British Museum which on the whole form a very uniform series:—

S. Coorg, Virajpet, 3,000 ft. (Shortridge). An ad. ♂, January 30, is dark brown with fine buff speckling; an ad. ♀, January 27, is blacker with greyer buff speckling; the contour hairs being about 42 mm. in both.

Palni Hills, Tiger Shola, 5,700 ft. (McCann). An ad. ♂, April 24, is like the ♀ from Virajpet; an ad. ♀, April 27, is like the ♂ from Virajpet. The coat in the ♂ is about 64 mm., in the ♀ about 44 mm.

Madura, High Wavy Mt., 5,000 ft. (Prater), a skin like the ♂ from Virajpet, with the coat 46 mm.

Travancore, Primerd in Trivandrum, 3,800 ft. (Ferguson), one skin with the pale speckling rather finer and duller than in the preceding and the coat 53 mm.

Nilgiri Hills, Ootacamund (Gosse), July, a skin very similar to the ♂ from Virajpet, but the coat is 59 mm. and the underwool thinner.

'Madras' (Jerdon). An undated specimen, marked by Thomas as doubtless from the Nilgiris, is rather paler than the rest, owing to the pale bands of the contours, which are 40 mm. long, being noticeably wider. In this respect it is most strongly contrasted with the Travancore skin and with the type in which the speckling is fine and the general colour brown, with the contour hairs 42 mm. as in the ♂ from Virajpet.

The flesh measurements in English inches and weights of some specimens in the British Museum are as follows:—

—		Head and body.	Tail.	Hind-foot.	Weight lbs.
S. Coorg	... ad. ♂	19⅕	12⅘	3⅖	6
Madura	.. ad. ♂	17⅕	12½	...	5
Palni Hills	... ad. ♂	16⅘	12	3	3
,,	... ad. ♂	14⅖	10	3	3
S. Coorg,	.. ad. ♀	16⅘	12	3	3½

These dimensions suggest that Coorg specimens are on the average larger than those from the Palni Hills; but the data are insufficient to warrant the conclusion that more than one race is represented. The length of the head and body is larger on the average than in *H. edwardsii* and the tail is manifestly much shorter.

The skulls vary comparably to the skins. The two ♂ skulls entered in the table (p. 239) are not quite the largest and smallest in length and width. Actually the longest is the skull of the skin from Madura with a condylobasal length of 89 mm., and the shortest a second skull from the Palni Hills with the same length 82 mm. The widest is that of the type with a zygomatic width of 49 mm. and a maxillary width of 18 mm., the condylobasal length being 87 mm., very nearly the same as the ♂ from S. Coorg.

Herpestes fuscus flavidens, Kelaart.

Herpestes flavidens, Kelaart, *Journ., R. As. Soc. Ceylon*, ii, p. 323 (1850); id. *Journ., A. S. Soc. Beng.*, xx, p. 184 (1851); id. *Prodr. Fauna Zeyl.*, p. 44 (1852); Ryley, *Journ., Bomb. Nat. Hist. Soc.*, xxii, p. 106 (1914); Thomas, *Ann. Mag. Nat.* (9), xiii, p. 239 (1924); Phillips, *Man. Mamm. Ceylon*, p. 180 (1935).

Herpestes fulvescens, Kelaart, *Journ., As. Soc. Bengal,* xx, p. 162 (1851) and xxi, p. 348 (1852); Blanford, *Mamm. Brit. Ind.*, p. 127 (1888), (in part).

? *Herpestes ceylanicus,* Nevill, *Taprobanian,* i, p. 62 (1887).

Herpestes flavidens ceylanicus, Thomas, *Ann. Mag. Nat. Hist.* (9), xiii, p. 240 (1924); Phillips, *Man. Mamm. Ceylon,* p. 186 (1935), (*ceylanicus*).

Herpestes flavidens phillipsii, Thomas, *Ann. Mag. Nat. Hist.* (9), xiii, p. 240 (1924).

Locality of types of *flavidens* and *fulvescens,* Kandy; of *ceylanicus,* Trincomalee; of *phillipsii,* Gammaduwa, E. Matale.

Distribution: Throughout the mountainous districts of the Central Province to over 6,000 ft., westwards to the coast near Colombo in the wet zone and eastward to Uva in the dry zone (Phillips).

A little smaller than the South Indian race, with the coat on the average shorter both on the body and tail and the pale speckling typically, but by no means aways, a little brighter, the under side usually not so brown and the tip of the tail as a rule brighter than its more proximal portion, its long hairs being more uniformly ochreous or reddish with obsolete black bands.

It was probably an examination of specimens of this race that induced Anderson to record *fuscus* as occurring in Ceylon. To this Blanford demurred on the grounds that *fuscus* was in his opinion replaced in Ceylon by *fulvescens* (=*flavidens*) which he regarded as a distinct species on account of its much smaller size. He was, however, unacquainted with the smaller specimens of *fuscus* and the larger Ceylonese specimens, subsequently collected, showing complete intergradation between the two in dimensions.

The following specimens in the British Museum, assigned to this race, show considerable variation in colour:—

Kandy. Two examples collected by White are topotypes of *flavidens.* An ad. ♂ from the 'neighbourhood of Kandy' (No. 77.11.1.1) is dark brownish in general hue, the contour hairs being almost ochreous, this tint becoming dominant towards the end of the tail which has the tip reddish. This specimen possibly resembles a specimen from Newera Eliya which Kelaart recorded as a 'much darker variety than the one from Kandy'.

Another ♂ (No. 77.3.14.3), labelled Kandy, is much paler because the black in the contour hairs is not so dark and the pale speckling not so richly tinted and a little more extensive. Both these skins are undated; but the difference between them may be seasonal.

Pattipola, C.P., 6,210 ft. Two ad. ♂ (E. W. Mayor), March 2 and 14, were identified by Thomas as *flavidens.* They closely resemble the second of the two Kandy skins recorded above but are a little darker and have the pale speckling a trifle finer, in both these respects coming a little nearer the first of the topotypical examples.

Mousakanda in Gammaduwa, E. Matale, C.P., 3,000 ft. An ad. ♂ (W. W. A. Phillips), August 20, is very like the specimen from Pattipola but has the pale speckling greyer not so yellow and the tail is not so reddish at the end. This example is the type of *phillipsii* Thos.; but according to Phillips *phillipsii* cannot be maintained because the pale olivaceous tint on which it was based is purely an individual feature. Probably the difference between it and the specimen from Pattipola is seasonal and due to bleaching of the Gammaduwa skin. A second specimen, November 12, from the same locality, tolerably closely resembles the Pattipola skins, but is a trifle darker.

Kumbukkan in Uva, ad. ♀ (E. W. Mayor), July 20, very closely matches the first described darker specimen from Kandy, but is a trifle darker, the two being more alike than are the two skins from Kandy, except that the tip of the tail in the Kumbukkan skin is like the rest of that organ and not dominantly reddish ochreous. This specimen was identified by Thomas as *ceylanicus* Nevill, the type of which came from Trincomalee. Phillips unfortunately was unable to examine specimens either from Kumbukkan or Trincomalee. He therefore followed Thomas and reproduced Nevill's description of *ceylanicus.* I can find nothing in Nevill's description of *ceylanicus* to distinguish it from *flavidens;* but the final relegation of *ceylanicus* to the synonymy of *flavidens* must await the discovery of additional examples from Trincomalee. At all events the Kumbukkan skin is more like the darker Kandy skin than are the skins from Pattipola and Gammaduwa.

The following are the flesh measurements in English inches and weights of some specimens in the British Museum, supplemented by others taken from Phillips's volume: —

		Head and body	Tail	Hind-foot	Weight lbs.
Gammaduwa ...	ad. ♂	$16\frac{1}{5}$	$11\frac{2}{5}$	3–	2·2 oz.
Pattipola ...	ad. ♂	15	$11\frac{1}{5}$	3–	...
,, ...	ad. ♂	$14\frac{2}{5}$	$10\frac{4}{5}$	$2\frac{4}{5}$	2
Average of 5 (Phillips) ...	ad. ♂	15	10	3–	$2\frac{1}{2}$
Largest ,, ...	ad. ♂	$16\frac{1}{5}$	12-	3–	$3\frac{1}{2}$—$2\frac{1}{2}$
Kumbukkan ...	ad. ♀	$13\frac{4}{5}$	$11\frac{1}{5}$	$2\frac{3}{5}$	
Average of 4 (Phillips) ...	ad. ♀	13	9†	$2\frac{1}{2}$	1·11 oz.
Largest ...	ad. ♀	14	$9\frac{3}{5}$	$2\frac{4}{5}$	$1\frac{3}{4}$

The largest of these specimens are only a little smaller than the smallest of the South Indian race.

Herpestes fuscus rubidior, subsp. nov.

Herpestes flavidens maccarthiae, Thomas, *Ann. Mag. Nat. Hist.* (9), xiii, p. 239 (1924), (in part); Phillips, *Man. Mamm. Ceylon,* p. 184 (1935), (not *maccarthiae* Gray).

Locality of the type: Anasigalla, Matugama, W.P.

Distribution: 'Throughout the Kalutara District and the south-west of the island generally from about Panadura, 50 ft., in the Western Province to Matare and Tangalla in the Southern Province' (Phillips).

Distinguished from *flavidens* by being on the average a little larger and heavier and redder in its general colouring.

The one well preserved specimen known to me is the type, an ad. ♂ from Anasigalla Matugama, 100 ft. (W. W. A. Phillips), January 25, which was wrongly identified by Thomas as *maccarthiae*, Gray. The coat is full and longish, thicker if anything than in any of the above recorded skins of *flavidens* from high altitudes in the hilly region of Ceylon, and the general colouring, speckled red and black, is redder owing to the red rings in the contour hairs being a little more extensive and chestnut in hue; the tail is reddish at the end and the limbs are dark with fine pale speckling. The only other specimen assignable to this race that I have seen was collected at Yatiyantota, 500 ft., in the Southern Province (E. W. Mayor). It is a young, undated skin, faded and moulting, with many of the contour hairs shed especially on the belly. Hence the pale reddish speckling is not so conspicuous as in the type and is rather less extensive but the general hue is redder brown and paler than in the skins identified as *flavidens*.

In the adoption of this race I follow Phillips to whom it was well-known but, misled by Thomas, he identified it as *maccarthiae,* as recorded below.

The following flesh measurements in English inches and the weights of the type of this race are supplemented by others extracted from Phillips's records: —

		Head and Body	Tail	Hind-foot	Weight lbs.
Matugama (type) ...	ad. ♂	$16\frac{3}{5}$	$11\frac{2}{5}$	3	4
Largest (Phillips) ...	ad. ♂	$17\frac{4}{5}$	$12\frac{2}{5}$	$3\frac{1}{5}$	4
Average of 10 (Phillips)...	ad. ♂	16	11–	3 +	$3\frac{1}{4}$
Largest ,, ...	ad. ♀	$14\frac{4}{5}$	$10\frac{4}{5}$	$2\frac{1}{2}$ +	$2\frac{1}{4}$
Average of 5 ,, ...	ad. ♀	$13\frac{1}{2}$	10 +	$2\frac{1}{2}$	2

It will be noted that Phillips's largest ♂ is as large on the average as ♂ examples of the S. Indian race and that his largest ♀ is about the size of the smallest ♂ of that race from the Palni Hills. The table also bears out Phillips's statement that *rubidior* is on the average a trifle larger than *flavidens.*

The skull of the type, the only one known to me, is just adult, the nasal and maxillary sutures being still open. It is nevertheless well developed with complete orbits, a relatively high sagittal crest and a constricted post-orbital area. As the table of measurements (p. 239) shows it is practically as large as the ♂ skulls of typical *fuscus* from the Palni Hills.

Herpestes fuscus maccarthiæ, Gray.

Cynictis maccarthiae, Gray, *Proc. Zool. Soc.* (1851), p. 131, pl. 31.

Onychogale maccarthiae, Gray, *Proc. Zool. Soc.* (1864), p. 570.

Herpestes flavidens maccarthiae, Thomas, *Ann. Mag. Nat. Hist.* (9), xiii, p. 239 (1924), (in part).

Not *Herpestes flavidens maccarthiae,* Phillips, *Man. Mamm. Ceylon,* p. 184 (1935), (see above).

Locality of the type: Jaffna, the northern point of Ceylon.

Distinguished from the preceding races by its generally more uniformly dark, reddish-ochreous hue above and below, the dorsal contour hairs being only indistinctly speckled with blackish, whereas those of the flanks, belly and tail show no dark speckling; legs darker, dark brown with pale speckling; underwool yellowish brown, nearly the same colour from base to summit.

No flesh measurements are available.

No doubt it was the peculiar colouration of this Mongoose, very different from that of other species of *Herpestes,* which induced Gray to assign it originally to *Cynictis,* a S. African genus with a tolerably uniform, tawny pelage. Neither Anderson nor Blanford paid any heed to the peculiarities of this Mongoose, dismissing them apparently as untrustworthy on account of the animal having been kept in captivity. Blanford also seems to have doubted the truth of Gray's statement that it came from Jaffna; but it is highly improbable that either Gray or the collector, Mr. McCarthy, invented that locality. Thomas, unfortunately, overlooked or ignored the record. If he had known it, he would probably have detected the differences between Gray's type and the specimen from S.-W. Ceylon which he identified as *maccarthiae* (see above) and its resemblance to his type of *siccatus,* which he believed to be from Mannar.

The skull of the type and only known specimen is comparatively small and poorly developed although fully adult. The orbits are incomplete behind and there is no sagittal crest, the temporal ridges forming a narrow lanceolate area on the forepart of the crown and a very low median ridge behind. Possibly the development of the skull was arrested by captivity conditions; but it shows none of the modifications which normally affect the skulls of Mongooses and other Carnivores when reared from cubhood in a menagerie.

This race of *fuscus* is the type of the genus *Onychogale* Gray [*Proc. Zool. Soc.* (1864), p. 570], a name suggested apparently, as Anderson surmised, by the longish claws of the fore foot due to the only known specimen having been kept in a cage.

Herpestes fuscus siccatus, Thomas.

Herpestes flavidens siccatus, Thomas, *Ann. Mag. Nat. Hist.* (9), xiii, p. 240 (1924); Phillips, *Man. Mamm. Ceylon,* p. 187 (1935).

Locality of type possibly Aripo near Mannar, N.P.

Most nearly resembling *maccarthiae*, but the general colour nearly uniformly sandy or straw-like with very faint brown speckling in the pelage of the back but more pronounced on the nape and head; the flanks, cheeks, belly and tail without dark speckling; the under fur dark, greyish brown at the base, yellowish at the summit; legs darker than the body, brownish speckled with yellow.

The only known specimen, which has no skull or flesh measurements, was collected by Holdsworth and labelled Kandy; but since it is quite unlike other Mongooses from that district, Thomas suggested that it probably came from Aripo near Mannar on the north-west coast of Ceylon where Holdsworth is known to have secured other natural history material. This view is supported by the generally pale hue of the pelage which suggests an arid habitat. The skin looks like a bleached edition of the type of *maccarthiae* except for the sharp contrast between the dark base and the yellow summit of the under wool. In my opinion it is not unlikely that the types of these so-called races will prove to represent seasonal phases of a northern Ceylonese race, a view favoured by the locality of the type of *maccarthiae*; but I know of no other instance of such a marked seasonal difference in *Herpestes*.

Herpestes vitticollis, Bennett.

Herpestes vitticollis, Bennett, *Proc. Zool. Soc.* (1835), p. 67; and of subsequent authors including Blanford, *Mamm. Brit. Ind.*, p. 128 (1888); and Phillips, *Man. Mamm. Ceylon*, p. 190 (1936).

Crossarchus rubiginosus,[1] Wagner, *Schreber, Säug. Suppl.*, ii. p. 329.

Locality of type of *vitticollis*, Travancore; of *rubiginosus*, 'East Indies'.
Distribution: S. India and Ceylon.

One of the largest of the Oriental Mongooses invariably distinguishable by a black stripe running along the sides of the neck from behind the ear to the shoulder, composed of soft under fur and emphasized by the pale tips of the contour hairs above and below it. The tail, as in *fuscus*, is only about two-thirds the length of the head and body, but, unlike that species, the tip of the tail is black, the hind foot is naked below to the heel at all seasons and the contour hairs are long and coarse, 70-80 mm. on the rump, and variegated with from 5-10 coloured bands, usually a combination of whitish, black and chestnut red, the red especially prevalent and extensive on the tips of the dorsal contour hairs but very variable in its incidence and extent. The muzzle is typically blackish, the head black but grizzled; the chin and throat dusky and grizzled; the belly brownish or reddish, sometimes with grizzly speckling; the legs are mostly blackish and the wool of the back may be olivaceous grey throughout or yellow at the summit and black at the base.

The skull is considerably larger and altogether more robust, with deeper zygomatic arches, than that of the foregoing species; but the occipital and sagittal crests are less well developed so that the dorsal profile is more depressed and convexly curved behind. The greatest difference, however, lies in the large size, more conical shape and lower inferior projection of the posterior chamber of the bulla, a modification which results in the occipital condyles, the hamulars and the upper carnassial teeth being raised higher above a horizontal surface, when the skull rests upon it. A peculiarity of the teeth, which are more robust and less trenchant, is the presence of a distinct cingulum on the inner lobe of the first upper molar (m^1). There is also a trace of it on m^2.

This species is the type and sole representative of Gray's genus *Taeniogale* [*Proc. Zool. Soc.* (1864), p. 569].

The following account of some of the skins in the British Museum shows the colour-variations of this species:—

Travancore, Kolun. The *type* is reddish above from the nape backwards: on the fore body the hairs are extensively red at the tip, speckled brown and whitish below, but on the rump they are mostly red throughout with pale but no dark banding. Another from Travancore (Fry, No. 86.9.6.1), in good coat and colour, is, like the last, red from the nape to the black tail-tip but not so extensively, the hairs below being banded black and yellowish.

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[1] As pointed out above (p. 226) this name was wrongly assigned to the synonymy of *smithii* by Blanford following Kelaart, but correctly relegated to *vitticollis* by Thomas. Wagner described the neck as having a black spot on each side. In some skins the black stripe is reduced to a large spot when its two ends are concealed by the overlapping pale hairs above and below.

Palni Hills, Shambaganur, 6,000 ft. An ad. ♂, February 19, differs a little from Fry's Travancore specimen. It is red from the nape to the end of the tail, except for the tip, but there is not nearly so much red and the black and white speckling is everywhere more apparent.

S. Coorg, Wottekolle, 2,000 ft., January 2 and 5. An ad. ♂ and ♀ vary considerably. The ♂ has the fore back speckled yellow and black, not red as in the preceding specimens, but the hind back, rump, flanks and tail are extensively red and the fur of the back is yellow at the summit, black at the base. The ♀ is mostly dark grey above, the hairs banded black and white, not yellow, with buffish tips, but there is some red on the hair tips of the rump, thighs and tail; the flanks are grizzled, not nearly all red as in the ♂, and the fur is olive grey. The differences between these two skins, collected by Shortridge in the same place and at the same time of the year, are instructive. Another specimen from S. Coorg, an ad. ♂ from Srimangala, February 13, is intermediate in colour between the two from Wottekolle.

N. Kanara, Chipgeri, December 23, a ♂ is very like the ♀ from Wottekolle, the red setting in only on the rump.

Nilgiri Hills. A series of skins attests considerable variation. One is very like the ♂ from Wottekolle, another is practically all grey above, turning to yellowish on the rump, the others are intermediate between these two.

All the dated Indian skins, above described, as well as two from Haleri in N. Coorg, which are average in colouration, were collected between December and February. The differences in colouration are clearly not seasonal. On the other hand a series of five from Ceylon, namely three from Mousakanda, 3,000-3,400 ft., January 4 and October 8 (Phillips); one from Gammaduwa, 3,000 ft., August 8 (Phillips), and one from N. Eliya, May (Holdsworth), although extending over ten months of the year, are more uniformly coloured than the Indian set, having the hairs red at the tip from the head to the black tail-tip. It is worth noting that in the August skin from Gammaduwa the contour hairs are 80 mm., whereas in the January skins from S. Coorg they are barely 70 mm.

These Ceylon skins seem to bear out Blanford's idea that specimens from that island are on the average redder than those from S. India. There is no record, so far as I know, of skins from Ceylon showing hardly any red, like those from the Nilgiri Hills and N. Kanara. But none of the Ceylon skins is quite so red as the type of *vitticollis* from Travancore and they are not distinguishable from Fry's example from that district. Moreover the difference in 'redness' between the two skins from Wottekolle, S. Coorg, shows that colour-feature to be too variable to be relied on.

Some flesh measurements and weights are as follows:—

——		Head & Body	Tail	Hind-foot	Weight lbs.
South Coorg	... ad. ♂	$20\frac{4}{5}$	$13\frac{1}{5}$	4 +	$7\frac{1}{2}$
,, ,,	... ad. ♂	$20\frac{4}{5}$	$12\frac{2}{5}$	4 +	$6\frac{1}{2}$
Ceylon (Mousakanda)	... ad. ♂	$20\frac{3}{5}$	$11\frac{2}{5}$	$3\frac{2}{5}$	$5\frac{3}{4}$
,, ,,	.. ad. ♂	20	$12\frac{3}{5}$	$3\frac{4}{5}$	$6\frac{3}{7}$
South Coorg	... ad. ♀	19^1	$12\frac{4}{5}$	$3\frac{3}{5}$	6
North Coorg	... ad. ♀	20	10	$3\frac{4}{5}$	...
,, ,,	... ad. ♀	17	12	$3\frac{4}{5}$	...
Ceylon	... ad. ♀	19	$12\frac{1}{5}$	$3\frac{4}{5}$	$3\frac{3}{4}$
,, (aver. of 2)	... ad. ♀	$18_{\overline{2}}$ –	12 –	$3\frac{1}{2}$	...

On this list the measurements of the ♀ Ceylonese specimens are taken from Phillips's volume. The largest ♂ he recorded had a head and body length of 20 in. and the average of 4 ♂ was 19 in.; but there are two ad.

♂ skins in the Museum sent by him from Gammaduwa and Mousakanda both of which measure $20\frac{3}{5}$ in. in length of head and body. The dimensions exceed those of the previously described species, apart from some specimens of *H. edwardsii ferrugineus* from Kangra and Chamba, which are probably exaggerated. The weights also indicate a much more robust species as might be expected from the size of the skull, of which the dimensions are given below (p. 239).

Herpestes urva, Hodgson.

Gulo urva, Hodgson, *Journ., As. Soc. Beng.*, v, p. 238 (1836).

Urva cancrivora, Hodgson, *Journ., As. Soc. Beng.*, vi, pp. 561-4.

Mesobema cancrivora, Hodgson, *Journ., As. Soc. Beng.*, x, p. 910.

Herpestes urva, Anderson, *Zool. Res. Yunnan*, p. 189, pl. 9, figs. 5 and 6 (1878); Blanford, *Mamm. Brit. Ind.*, p. 129 (1888); and subsequent authors including G. M. Allen, *Amer. Mus. Novit.*, No. 359, p. 8 (1929).

Urva hanensis, Matschie in Filchner's *Exp. China-Tibet*, p. 190 (1907).

Herpestes urva annamensis, *formosanus* and *sinensis,* Bechthold, *Zeitschr. Säug.*, xi, pp. 150-2 (1936).

Locality of type of *urva* and *cancrivora*, Nepal; of *hanensis,* Hankow; of *annamensis,* Phu Qui, Annam; of *formosanus*, Formosa; of *sinensis,* Kuangtung.

Distribution: Nepal, Assam and Burma to S. China including Formosa and Hainan, Laos, Tonkin, Annam and the northern part of the Malay Peninsula.

A large Mongoose with a comparatively short tail, not more than two-thirds the length of the head and body, a stripe of white contour hairs extending from the corner of the mouth to the shoulder and the sole of the hind foot hairy nearly down to the hallux. General colour above black and white, the contour hairs white at the tip to a varying extent, when extensive giving a 'badger-like' appearance to the pelage, the subterminal band extensively black, the under hair ochreous or rusty, dark grey close to the skin; tail with its base like the back but becoming progressively ochreous or flavous towards the tip; head blackish or brown, speckled, contrasted with the brown muzzle; belly brown, speckled, some black on the chest and hind throat, but fore throat, chin and lower cheek white; legs black with very little speckling.

Skull much more robust than in *edwardsii*, *smithii,* and *fuscus*, its dorsal profile very like that of *vitticollis*, the occipital and sagittal crests being weak so that it is sloped posteriorly, but the bullae and teeth, although the teeth are a little larger, much as in the three first mentioned species.

In addition to *Urva* and *Mesobema,* quoted above, a third generic name *Osmetectis* Gray [*Ann. Mag. Nat. Hist.*, x, p. 260 (1842)] was assigned to this Mongoose by Anderson in 1879 and, following him, by Thomas in 1882. The reference is unintelligible. Gray proposed *Osmetectis* for an animal he had previously named *Viverra fusca* [*Hardw. Illustr. Ind. Zool.*, i, pl. 5 (1830)]. The figure most emphatically does not represent a Mongoose of any kind. It has an elongated snout and cat-like feet and was possibly taken from a skin of the Nepalese Palm Civet (*Paguma larvata grayi*); but at best it is a caricature.

The following notes on skins in the British Museum are added to show the individual variation, seasonal and otherwise, and to justify the synonymy given above:—

Nepal. Four of Hodgson's specimens show great variation in colour. One is well coloured, the contour hairs 58 mm., being black and whitish, the plentiful wool bright buff, or ochreous at the summit, dull brown at the base; the hairs of the ventral surface are brown turning to grey at the base; the legs blackish with a little pale speckling above the paws; the tail like the back at the base but more and more ochreous towards the tip, but the hairs are short and broken here and may have been grey-tipped. A second, marked cotype, is a moulting skin in dead coat, with the wool quite pale yellowish white at the summit and the tail not nearly so ochreous. A third, also a cotype, is like the last but has the legs chocolate and the dark bands of the contour hairs deep brown, not so black. The last offers the greatest contrast to the first, there being no yellow in the contour hairs or in the wool which is sooty grey; the hairs of the tail are yellowish grey at the base, then black with a grey tip.

Of two from Gorkha, Nepal (Baptista), one, November 26, agrees closely with Hodgson's first; the other, December 20, has the white tips of the contour hairs more extensive and the wool not quite so rich. Another from Nepal (Inglis) is duller in its wool, like Hodgson's cotypes.

Darjiling. A skin from Pashok (Crump), 3,000 ft., October 6, is like the Gorkha skin of December 20. One from Hasimara, Bhutan Duars, 600 ft., February 23, closely matches Hodgson's richly coloured skin; but one from Rajapara, S. Kamrup, 600 ft., November 17, has very little bright tint, except on the tail-tip, and fits in with Hodgson's duller skins. So also does one from Tura in the Garo Hills, 1,300 ft., the date being uncertain.

An undated skin from Sadya, N.-E. Assam, has a full long coat, about 70 mm., and has the rich ochreous under colour of the Darjiling skin, but the tips of the contours are more extensively white.

Burma. An undated skin from north of Mogaung, near the source of the Chindwin River (Capt. Abbey), is well coloured like the skin from Sadya, but has the under colour darker almost rusty ochreous, a yellow wash on the tips of the contour hairs of the back and the hairs of the tail mainly ochreous. One from the Chin Hills, November 13 (Hopwood) is very different from the last, being dull coloured with the wool drabby and the white tips of the contours small. One from 20 miles north-west of Kindat, 600 ft. (Mackenzie), April 19, is apparently moulting, there being no wool on the back but abundance on the flanks and purplish grey in colour. An ad. ♂ from Thandaung, near Toungoo, 4,500 ft., April 7, is very like the skin from Sadya, with a similar faint yellow wash and almost ferruginous-tipped wool. This skin also resembles the brightest of the Nepal series; but one from Tharawaddy agrees very well in colour with the duller Nepalese skins, although the coat has only a little greyish wool. Finally a skin from Rangoon, March 7, has the contour hairs black and white and 70 mm. long and the wool rather dull, greyish buff.

The above described skins ranging from Nepal to S. Burma in British Indian territory are broadly speaking so much alike and show so many cross resemblances in localities remote from each other that it is impossible to sort them into local races. The same applies to all the other skins in the British Museum from adjoining countries outside those limits. One from Xien Quang Koo, Laos, January 10; five from Backan Tonkin, 500 ft., December 17 to January 11; one from Phu Qui, Annam, 100 ft., the type of *annamensis*, Bechth., all collected by Delacour and Lowe and correctly, in my opinion, identified by Thomas and Osgood [*Field. Mus. N. H. Zool.*, xviii, p. 260 (1912)] as typical *urva*, are in well coloured winter coat and are inseparable from N. Indian and Burmese skins. Also the following Chinese skins, one undated from Tengyueh, Yunnan (Howell); and one from Foochow, March; one from Fokien, January 7; one from Chung Yang, S. Hupeh, January; one from Chinteh, Anhwei (Nyanhwei), May; and three from Bankoro, Formosa, fit in with the Indo-Chinese, Burmese and Indian skins. The Chinese skins have a bearing on the synonymy I have given of *H. urva*. Hankow, the type locality of *hanensis*, Matschie, lies between Hupeh and Anhwei and the likeness between my skins from these two districts and Indian and Burmese skins of typical *urva* confirms G. M. Allen's opinion that the alleged distinctive characters of *hanensis* have no systematic value. My two skins from Fokien, whence Allen had a good series, also support this view that the Crab-eating Mongoose of that district is inseparable from typical *urva*; and the agreement between the Fokien and Tonkin skins hardly admits of a doubt that the Kuangtung skins, described by Bechthold as *sinensis*, represent the same Mongoose. Three skins from Formosa in the British Museum I am unable to distinguish by any reliable character from Hodgson's Nepalese series. The alleged difference in the coat on which Bechthold relied when describing *formosanus* is probably seasonal, if existent. At all events in immature specimens from Formosa the contour hairs of the rump are 65 mm., whereas in two adult Nepalese specimens in good coat they are respectively 62 and 72 mm.

Very few flesh measurements of ad. ♂ specimens are available in the Museum material and none from the typical locality of *H. urva*. To the measurements of British Indian specimens have been added a few recorded by Delacour and Lowe from Indo-China.

——		Head and Body	Tail	Hind foot
Backan, Tonkin	... ad. ♂	22	12⅘	4 –
Toungoo, Burma	... ad. ♂	20⅕	13⅖	4 +
Gorkha, Nepal	... ad. ♀	20⅖	12⅘	4 +
,, ,,	... ad. ♀	18⅘	12⅘	4 –
Toungoo, Burma	... ad. ♀	19⅕	12⅕	4 +
Backan, Tonkin	... ad. ♀	20⅘	12⅕	4 –
Phu Qui, Annam	... ad. ♀	18⅘	11⅗	3⅘

There is very little difference between the sexes. It may be noted that the two ♀ specimens from Nepal agree respectively very closely with the two from Indo-China. Of the latter the one from Annam is the type of *annamensis*, Becht.

The weight of one of Mackenzie's Tonghoo specimens, a ♀ with the head and body 18 in., was 4½ lb. The weight of an ad. ♂ would no doubt be at least 6 lb. or over.

Skull Measurements of *H. fuscus*, *H. vitticollis* and *H. urva*.

Name, Locality and Sex		Cond. Bas. Length	Zygom. Width	Post. Orb. Width	Int. Orb. Width	Max. Width	Mand. Length	pm^4	m_1
H. fuscus fuscus									
Madura, Highwavy Mt.	ad. ♂	89	48	16	18	18	61	9 × 6	8
S. Coorg, Virajpet	ad. ♂	88	47	15	18	17	59	8 × 6	7
Palni Hills, Tiger Shola	ad. ♂	83	44	15—	—	16	55	8 × 5½	8—
H. fuscus rubidior									
Anasigalla (type)	ad. ♂	83	43	13	16	15 +	54	7 × 5	7
H. fuscus flavidens									
Kandy	yg. ad ♂	79	42	13	15	15	53	7½ × 5½	7
Mousakanda	yg. ad. ♂	75	38	14	14	15	50	7½ × 5	7
Kumbukkan	ad. ♀	75	40	13	15	13½	48	7 × 5	6
H. fuscus maccarthiae									
Jaffna (type)	ad. ♀	71	37	13	14 –	13	—	7½ × 5	–
H. vitticollis									
S. Coorg, Wottekolle	ad. ♂	103	58	19	22	22	72	10 × 7½	9 +
N. Coorg, Haleri	ad. ♀	98	54	20	21	21	70	9½ × 8	9½
Ceylon, Gammaduwa	ad. ♂	100	57	19	23	21	71	10 × 7	9
H. urva									
Burma, Ruby mines	ad. ♂	98	56	17½	20	20	67	9 × 6½	9 +
,, Toungoo	ad. ♂	97	56	15	21	21	69	9 × 7	9—
Nepal, Gorkha	ad. ♀	95	54	13½	18	19	65	9 × 6½	9—
,, ,,	ad. ♀	90	52½	15	20	19	63	9 × 7	9

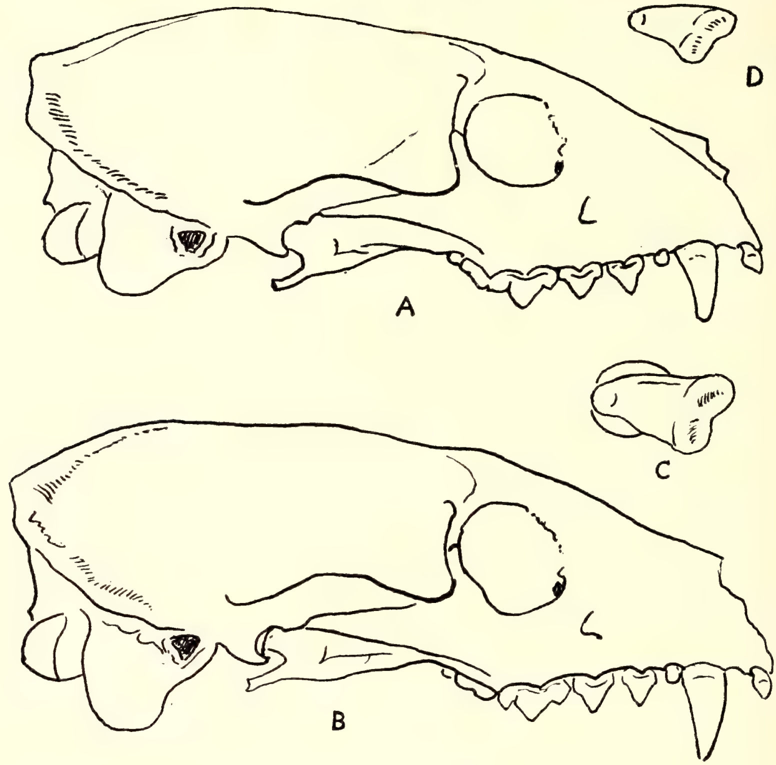

Fig. 2.—A. Skull of adult ♂ of *Herpestes urva* from the Ruby Mines, Burma.
B. Skull of adult ♂ of *Herpestes vitticollis* from S. Coorg.
C. First upper molar of left side of *Herpestes vitticollis.*
D. The same of *Herpestes edwardsii nyula.*

Herpestes javanicus, Geoffroy.

Ichneumon javanicus, Geoffroy, *Descr. de l'Egypte. Hist. Nat.*, ii, p. 138 (1812).

Distribution: From Persia, through Northern India and Burma to Indo-China, Hainan, Siam, the Malay Peninsula and Java.

In the British Indian representatives of this species the size is small, with the tail always shorter than the head and body but usually over two-thirds the length; the coat is always short and soft to silky, when fresh, and although the general colour is variable seasonally and individually, the speckling is always fine, the contour hairs having as a rule only five rings of which two are pale; the under wool is characteristically yellow at the summit and black at the base and the legs are about the same tint as the body with the paws often paler.

In its general shape the skull is like that of *H. edwardsii* without the bulging forehead and the posterior chamber of the bulla is less inflated and scarcely projects below the anterior.

Although there is a great difference not only in size but in colour between the western race of this species, *pallipes,* and the eastern race, *javanicus,* the two are linked by intermediate forms, the Burmese race *birmanicus* coming very close to the Malayan race, *perakensis,* which connects it with the Siamese and Indo-Chinese race, *exilis,* the latter being similarly closely related to the typical Javan race *javanicus,* the largest of all, very nearly as large as *H. edwardsii.* The Indian and Burmese races differ from those found to the east and south-east of Burma in Continental Asia by being a little smaller, by having the crown of the head the same or almost the same tint as the body and by the complete absence of red in the pelage. In the others the head is at least darker, is nearly always some shade of red and redness is a very prevalent feature on the body and tail.

Herpestes javanicus auropunctatus, Hodgs.

Mangusta auropunctata, Hodgson, *Journ., As. Soc. Beng.,* v, p. 235 (1836).
Herpestes nepalensis, Gray, *Charlesw. Mag. Nat. Hist.,* i, p. 578 (1837).
Herpestes auropunctatus, Blanford, *Mamm. Brit. Ind.,* p. 121 (1888), (in part, excluding *pallipes* and *persicus*).
Mungos auropunctatus auropunctatus and *H. nepalensis,* Wroughton, *Journ., Bomb. Nat. Hist. Soc.,* xxvi, pp. 54-5 (1918).

Locality of type of *auropunctatus,* Nepal; of *nepalensis,* 'N. India' (Hodgson).
Distribution: N. India from Kashmir to Bhutan; Assam, Manipur and Bengal, south of the Ganges as far south as Chilka in Orissa.

Distinguished from the previously described British Indian Mongooses by its smaller size and shorter coat, the contour hairs in winter being at most up to about 20 mm. long, very soft and speckled with about five alternating bands; also by the legs being about the same tint as the body with the paws often a little paler than the areas above them, at all events not darker. The general colour varies considerably according to the season, but the speckling of the contour hairs is always fine, although more extensive when the coat is longer; the wool when fully grown is fairly abundant, dark at the base, pale at the summit and the tip of the tail does not differ conspicuously from the rest of the organ.

These characters apply in general to the other two British Indian races of *javanicus* in which, as in *auropunctatus,* the tail is considerably shorter than the head and body.

The following account of some skins in the British Museum attests great individual variation in colour.

Nepal. Eight undated skins (Hodgson), vary greatly in length of coat, amount of under wool and colour, the differences being no doubt seasonal. No two skins are exactly alike, the greatest contrast being between one (No. 43.1.12.124) in which the general tint is dark brown, with minute, nearly ochreous speckling, the contour hairs being short, the scanty wool brownish, and another (No. 43.1.12.20) which is comparatively pale, the pale speckling of the contour hairs being much more extensive and buffy grey to whitish and the more luxuriant wool greyish yellow at the summit, dark grey at the base. The first no doubt represents the new summer coat, the second the bleached winter coat. Another phase is shown by a skin (No. 45.1.8.321) which is pale brown, with fine grey speckling. The best coated of the series (No. 43.1.12.22) has the contour hairs about 20 mm., boldly speckled buffy yellow and blackish, with the wool ochreous at the summit, blackish brown at the base; the tail greyer than the body, the legs like the body, with the paws a little paler and unspeckled, the under side drabby, the hairs of the abdomen being browner at the base and showing some dark speckling. This skin exhibits, I believe, the unfaded winter coat. The rest of the skins differ in various details, linking those above described; and the type of *nepalensis,* Gray, also one of Hodgson's skins, regarded by Wroughton as representing a distinct 'species', fits in with the shorter coated, more finely speckled examples.

Of Nepalese skins from precise localities, one from Khatmandu (Scully), March, closely resembles Hodgson's (43.1.12.22) several from Gorkha (Baptista), November 30 to March 21, and two from Yodaveri, 7,000 ft. (Kennion), November 16, agree essentially with Hodgson's series, Kennion's skins being comparatively short coated and finely speckled.

Kashmir. Five skins resemble the Nepalese and show similar variations. One (Ward) without special locality, 6,300 ft., September 13, has the coat 13 mm., with very little, nearly uniformly dark grey under wool. One from Tral, 5,800 ft. (Stockley), October 7, has the coat 16 mm. Two from Kajerskote, 5,500 ft. (Ward), January 12 and 22, have the coat 20 mm., and in other respects resemble the March skin from Khatmandu and Hodgson's (43.1.12.22), and one from Manarsbal, Wular Lake (Dunn), May 31, has the coat short, 14 mm. and the pale speckling of the contour hairs greyish.

From countries to the east of Nepal there are skins from Hasimara in Bhutan Duars, 600 ft. (Baptista), November 18 to February 28, which generally agree with the Nepal series, one skin being much darker than the others; one from Cooch Behar, March, is speckled silvery and black, a little paler than Hodgson's palest but obviously the same; five from Angarakata in N. Kamrup, Assam, 300 ft., December 23 to February 28, are like the specimens from Bhutan and Gorkha in Nepal; two from Golaghat, Assam, 250-300 ft., January 13 and 26, have the pale speckling yellowish white to white, one, the whiter of the two, which closely matches the Cooch Behar skin, has some almost wholly white hairs on the nape and fore back, giving these areas a hoary aspect; one, undated, from Dilkoosha in Cachar, almost exactly matches the skins from Gorkha in Nepal; whereas one from the Jaintia Hills, 3,000 ft., July 26, with the coat very short, finely speckled with buff and the wool uniformly dark, is like the skins from Yodaveri in Nepal. Finally a skin from Manipur (Hume), March 11, identified by Blanford as *birmanicus*, has the coat full, 20 mm. long, and only differs from the example of typical *auropunctatus* from Khatmandu, also collected in March, in having the pale speckling a trifle yellower, less ochreous.

There are three skins from localities south of the Ganges in N.-E. India. A ♂ from Midnapore, 200 ft., September 11, has the coat thin and short, the general colour darkish, with very fine yellowish or buff speckling, the wool very scanty and mostly grey, the two normal tints being merely slightly indicated. A ♀ from Nimiaghat, Hazaribagh, 1,000 ft., June 12, is as finely speckled as the Midnapore skin, the coat being equally thin and short, but the general colour is paler and yellower, the pale speckling being richer in hue and the dark speckling browner, not so black. The third, a ♀ from Satpara Puridish in Orissa (Chilka Survey), is undated but is in good coat and in its whitish pale speckling and in the tint of its well developed under fur it closely matches Hodgson's pale speckled Nepalese skins. The well marked differences between these three skins are probably merely seasonal and there is no evidence that they are either separately or collectively racially distinct from *auropunctatus*.

This race under the name *nepalensis* is the type of the genus *Calogale* Gray [*Proc. Zool. Soc.* (1864), p. 560].

It was this small Mongoose, not *H. edwardsii* as formerly supposed, that was introduced into the West Indies, and is now found in most of the islands, the British Museum having specimens from Jamaica, St. Lucia, Barbados and elsewhere. This was pointed out by G. M. Allen [*Bull. Mus. Comp. Zool.*, liv, p. 217 (1911)] who identified his specimens as *Herpestes birmanicus* and told the story of the shipment of the original consignment from Calcutta to Jamaica.

Herpestes javanicus pallipes, Blyth.

Mangusta pallipes, Blyth, *Journ., As. Soc. Beng.*, xiv, p. 346 (1845) and xv, p. 169 (1846).

Herpestes persicus, Gray, *Proc. Zool. Soc.* (1864), p. 554.

Herpestes auropunctatus, Blanford, *Mamm. Brit. Ind.*, p. 121 (1888), (in part).

Mungos auropunctatus helvus, Ryley, *Journ., Bomb. Nat. Hist. Soc.,* xxii, p. 661 (1914).

Mungos auropunctatus pallipes and *helvus,* Wroughton, *Journ., Bomb. Nat. Hist. Soc.,* xxvi, pp. 54-5 (1918).

Locality of the type of *pallipes,* Kandahar; of *persicus,* Khuzistan and Mohammerah, W. Persia; of *helvus,* Deesa in Palanpur, N. Gujerat.

Distribution: The deserts of N.-W. India; Afghanistan; Persia.

Distinguished on the average from *auropunctatus* by its paler, generally greyer colour above and usually whiter colour below.

The following account of some of the skins in the British Museum affords justification for the synonymy given above:—

Afghanistan. Three skins from Kandahar, topotypes of *pallipes* Blyth, collected by Hutton and St. John, and one labelled Afghanistan collected by Griffiths and also probably a topotype, vary considerably in colour. Griffiths' skin is darkish, olivaceous, speckled brownish black and buffy, with normally tinted wool and the coat 17 mm. Of the three skins from Kandahar, two have the coat the same length and the wool the same colour as in Griffiths's skin, but the general colouration is much lighter, owing to the whitish speckling, the speckling being broader in one than the other. This specimen, dated February 2, shows that the others, with similar coat and wool, are winter skins, but Hutton's Kandahar skin, with the coat only 10 mm., and indifferently speckled, the wool very short and yellowish olive showing between the thinned contour hairs, is obviously moulting.

A skin from Seistan on the Perso-Afghan border (Kennion) is almost an exact match of St. John's Kandahar skins; the co-types of *persicus* from Khuzistan and Mohammerah, near the head of the Persian Gulf, similarly resemble Griffiths's Afghan skin and two from Mesopotamia are respectively like Griffiths's and one of St. John's Kandahar skins. These data show that *persicus* is a synonym of *pallipes* as Blanford maintained. Wroughton gave no reasons for his opinion that *persicus* is distinct.

A very large number of skins collected from the deserts of N.-W. India, principally in Sind by Prater and McCann for the Survey, was correctly identified as *pallipes* by Wroughton and others. Of these a series from Tatta, Gharo, Keti, Bagan on the Indus, Bohara near Karachi, is dark and brownish grey in hue, although varying individually; several from Gambat in Khairpur, April 6 to 10, are darkish grey or paler like the Afghan skins. Of four skins from Larkhana, one, March 22, is grey and matches St. John's Kandahar skins; the others, May 9, are dark skins in bad coat like the brownish skins from the Karachi district; and one from Jacobabad, February 27, is like the two pale Kandahar skins and the one from Seistan, and the same applies to a skin from the Salt Range in the Upper Punjab, March 12. Finally seven more or less faded skins, collected by Crump at Deesa, Palanpur, 450 ft., April 25 to May 5, were described by Ryley as *helvus.* This race was adopted by Wroughton; but three at least of the better coloured skins almost exactly match the skin from Seistan and may be described as slightly faded editions of St. John's topotypes of *pallipes.* The type of *helvus,* May 5, has the dark speckling still more faded and the partial exposure of the wool by the thinning of the contour hairs helps to give the yellowish appearance upon which the race was based. Another has the moult of the contour hairs still further advanced and is yellower than the type. The evidence that *helvus* is a valid race is in my opinion negligible.

Some skins from Gwalior (Riley O'Brien) agree on the whole better with this race than with *auropunctatus.*

Herpestes javanicus birmanicus, Thomas.

Herpestes birmanicus, Thomas, *Ann. Mag. Nat. Hist.* (5), xvii, p. 84 (1886) and *Proc. Zool. Soc.* (1886), p. 58; Blanford, *Mamm. Brit. Ind.,* p. 122 (1888); Wroughton, *Journ., Bomb. Nat. Hist. Soc.,* xxvi, pp. 54-5 (1918).

Locality of the type: Pegu.
Distribution: Lower Burma from Toungoo to Tenasserim.

Distinguished from *auropunctatus* of Northern India and Assam by its slightly larger average size indicated particularly by the skull.

Although regarded as a distinct species by Thomas, Blanford and Wroughton, this Mongoose is clearly nothing but a local race akin to the typical North Indian form *auropunctatus*, with which it completely intergrades. Blanford indeed recorded it from Manipur and Cachar, but for what reason is not clear. The only skin from Cachar I have seen is inseparable from Nepalese specimens, although it exactly matches in colour the type of *birmanicus* from Pegu (Oates), April 10.

A series of nine skins from Toungoo, 100 ft. (J. M. D. MacKenzie), May 23 to August 16, shows considerable variation in colour, some closely agreeing with the type. Most of them, dating from May 26 to June 13, have short coats, are dark brown in colour, with fine pale ochreous speckling, the wool scanty and not noticeably bicolor and closely resemble the skins of *auropunctatus* from Yodaveri in Nepal; but one, May 23, is much lighter, with less black and paler yellowish speckling almost exactly as in typical *nepalensis*, and another, August 16, is lighter than the last, has a longer coat and consequently more extensive pale speckling, which is also rather brighter yellow, and the wool is beginning to be differentiated into the two normal tints. Finally one from the Sittang delta, 40 miles south of Pegu, March 4, is yellower than any, with a longer coat and broader pale bands, normally bicolour wool, in all respects nearly matching the better coloured of Hodgson's Nepalese series.

Flesh measurements in English inches of some specimens of the three races of this species are as follows:—

——		Head and Body	Tail	Hind foot
auropunctatus				
Bhutan Duars ...	ad. ♂	$13\frac{1}{5}$	$10\frac{1}{5}$	$2\frac{2}{5}$
Kajetrsgkote, Kashmir ...	ad. ♂	$12\frac{4}{5}$	$10\frac{4}{5}$	$2\frac{2}{5}$
Gorkha, Nepal ...	ad. ♀	$12\frac{1}{5}$	$9\frac{5}{8}$	$2\frac{1}{5}$
Bhutan Duars ...	ad. ♀	$11\frac{3}{5}$	$9\frac{3}{5}$	2+
pallipes				
Larkhana, Sind ...	ad. ♂	$12\frac{1}{2}$	$9\frac{1}{5}$	$1\frac{4}{5}$
Palanpur, Gujerat ...	ad. ♂	12+	$10\frac{3}{5}$	2
,, ,, ...	ad. ♀	$11\frac{1}{5}$	$9\frac{2}{5}$	$1\frac{4}{5}$
Larkhana, Sind ...	ad. ♀	$10\frac{3}{5}$	$8\frac{3}{5}$	$1\frac{2}{5}$
birmanicus				
Tounghoo ...	ad. ♂	$14\frac{4}{5}$	$11\frac{3}{5}$	$2\frac{1}{2}$
,, ...	ad. ♂	$13\frac{4}{5}$	9	$2\frac{1}{5}$
,, ...	ad. ♀	$12\frac{4}{5}$	10	2+

SKULL MEASUREMENTS OF THE BRITISH INDIAN SUBSPECIES OF *Herpestes javanicus.*

NAME, LOCALITY AND SEX	Cond. Bas. Length	Zygom. Width	Post. Orb. Width	Int. Orb. Width	Max. Width	Mand. Length	pm^4	m_1
auropunctatus								
Kajersgkote, Kashmir ad. ♂	66	34	10	13	12	42½	6 × 5	6
Nepal ad. ♂	62	30	12	12	11½	40	6 × 5	6
Bhutan Duars ad. ♂	66	33	10	11	11	43	6 × 4	6–
,, ,, ad. ♂	61	31–	9	11–	11–	40	6 × 4½	5½
Orissa, Khurdu ad. ♂	59	30	10	11	10	...	6 × 4	...
Nepal, Ghorka ad. ♀	63	31	10½	10½	11	41	6 × 5	6–
Bhutan Duars ad. ♀	61	29	10½	11	10½	38½	6 × 4	6
,, ,, ad. ♀	57	30	9	10	10	...	6 × 4	...
Orissa, Satpara ad. ♀	63	30	12½	11	11	40	6 × 4	5
pallipes								
Kandahar ad. ♂	66	34	9	12	12	43	7 × 4½	6
Persia (*persicus* co-type) ad. ♂	(63 ±)	32	10–	12	12–	...	6 × 4½	...
Gwalior ad. ♂	65	33	9	11½	12	42	6 × 5–	5½
Palanpur (*helvus* type) yg. ad. ♂	63	30	10	11–	10½	40	7 × 5	6
,, ,, ad. ♂	58	30	10	11	11	37	6 × 4	6–
Sind, Sukkur ad. ♂	58	30	9	11–	11–	...	6 × 4	...
Palanpur ad ♀	57	29	8½	10	10	35	6 × 4	5
birmanicus								
Pegu (type) ad. ♂	67	34	11½	12	13	44	6½ × 5	6
Toungoo (largest) ad. ♂	71	40	11	13	13½	47½	8– × 5	6
,, Average of 4 ad. ♂	68	...	...	...	...	...	...	...
,, ,, ad. ♀	65	31	8	11	11	41	7 × 4	6
,, Average of 3 ad. ♀	64	...	...	...	...	...	...	...

THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.

(ORNITHOLOGICAL SECTION).

BY

HUGH WHISTLER, M.B.O.U., assisted by N. B. KINNEAR, M.B.O.U.

PART XV.

(Continued from page 698 of vol. xxxviii).

Larus ichthyaëtus Pallas.

Larus ichthyaëtus Pallas, Reise Russ. Reichs, vol. ii (1773), p. 713—Caspian Sea.

No gulls were procured by the Survey. The Great Black-headed Gull is doubtless a winter visitor to the whole extent of the coastline of the Presidency, though it is as yet only recorded from three localities. William Davison obtained a female in full summer plumage on 20 March 1876 at Gopalpore on the Ganjam coast. This was made by Hume into the type of his *Larus innominatus* (*S.F.*, viii, 394) and the specimen is in the British Museum. Jerdon says that he saw it on the seacoast at Madras and one of his specimens is in the British Museum as well as two birds from the Hume collection obtained in the Madras roads in March.

On the Travancore coast Ferguson states that in February 1903 his collectors shot 5 specimens at Kayankolam Bar, though none had been seen there earlier in December.

Larus ridibundus ridibundus Linnaeus.

Larus ridibundus ridibundus Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 225—England.

Jerdon says that he never met the Black-headed Gull in Southern India and Dewar in calling this the only gull that is common at Madras must surely have confused it with *Larus brunnicephalus*. Ferguson found it fairly common at Kayankolam Bar on the Travancore coast in January 1903. Two Travancore specimens collected by Bourdillon at Quilon on February 24th are in the British Museum.

Larus brunnicephalus Jerdon.

Larus brunnicephalus Jerdon, Madras Jour. Lit. Sci., vol. xii (1840), p. 225—West coast of India.

The Brown-headed Gull is evidently a common winter visitor to the coast of Madras and the fact that it is found about the coasts of Ceylon from October to March (Legge) suggests its probable dates for our area. Armstrong (*S.F.*, iv, 459) records that in the Madras roads at the end of March the majority were assuming breeding plumage, though only one was seen which had completed its moult.

As regards the west we have Hume's record (*S.F.*, iv, 456) that there were a very few about at Kolachel on 27 February 1876; Ferguson's record of numbers in attendance on some men fishing in a shallow lake near Cape Comorin in December 1903; and the adult male in the British Museum collected at Quilon in February 1880 (Hume collection). An adult from Cannanore (Haines) is in the Tweeddale collection.

[**Larus hemprichii** Bruch.

Larus hemprichii Bruch, Journ. für Orn. (1853), p. 106—Red Sea.

Dewar states that a specimen of Hemprich's Gull labelled 'Madras' is in the Madras Government Museum. This locality is so far removed from the ordinary range of this gull, which has not been recorded nearer than Bombay, that it is difficult not to suspect a mistake and reserve the inclusion of Hemprich's Gull in the Presidency list.]

Larus sp.?

There is another large gull which is evidently a fairly common winter visitor to the coasts of the Presidency but at the moment it seems quite impossible to settle to what species it is to be attributed—for the taxonomy of this group is now in complete confusion owing to the latest researches on the subject, ending with Meinertzhagen's paper in the *Ibis*, 1935, p. 762—or to what subspecies, for the only two specimens in the British Museum [♂ 21-2-80 Travancore (Bourdillon) and ♀ 24-2-80 Quilon (Bourdillon)] are in immature plumage. A few adult feathers on the mantles of these specimens suggest to me that they belong to the Herring Gull type—*Larus cachinnans* of the *Old Fauna* (iv, 305)—which Armstrong (*S.F.*, iv, 459) under the name of *Larus leucophaeus* found in the Madras roads at the end of March, all more or less in immature plumage.

They were however labelled *Larus affinis* by Howard Saunders, who therefore considered them of the Lesser Black-backed Gull type, to which Ferguson attributed a specimen obtained by his collectors at Kayankolam in January 1903.

Chlidonias hybrida indica (Stephens).

Viralva indica Stephens, in Shaw's General Zoology, xiii, pt. i (1826), p. 169—Cawnpore.

Not obtained by the Survey. The Whiskered Tern is stated by Ferguson to be abundant in north Travancore, frequenting the coast, the backwaters and the paddy fields in the winter months.

The only other record that I find for the Presidency is afforded by the specimen in the Madras Museum collected at Tada in Nellore district.

There seems to be a good deal of confusion about the race of Whiskered Tern found in Ceylon. Stuart Baker (*New Fauna*, vol. vi, p. 113) says that birds from Ceylon are decidedly paler than Indian birds and he accepts with some hesitation *Ch. leucopareia leggei* Mathews, *Birds of Australia*, vol. ii (1913), p. 320—Ceylon as an island race. In *Nidification* (vol. iv, 361) he states that the Ceylon form, though darker than the Indian, cannot be separated from the Javan bird. I have carefully examined the series of 6 specimens from Ceylon in the British Museum and cannot separate them in any way from Indian birds and it is perhaps worth recalling the fact that neither Legge nor Wait have been able to ascertain that the Whiskered Tern breeds in Ceylon.

[**Sterna leucoptera** Temminck.

Sterna leucoptera Temminck, Man. d'Ornith., ed. i (1815), p. 483—Mediterranean Sea.

In the *New Fauna* (vi, 114) the White-winged Black Tern is said to migrate south to all western India and again to be common all down the east coast of India. The unwary might be led by this to expect to find the bird normally in the Presidency, so it may be as well to emphasise the fact that the *Old Fauna* (iv, 309) states that it has not been clearly identified from any part of India west of Tippera and I have seen no evidence to make me disagree with this statement.]

Hydroprocne caspia caspia (Pallas).

Sterna caspia Pallas, Nov. Comm. Acad. Sci. Petrop., vol. xiv (1770), p. 582—Caspian Sea.

Not procured by the Survey. The Caspian Tern no doubt occurs all round the coast of the Presidency but it is only recorded on the eastern side from

Madras by Dewar. In Travancore Ferguson found it in fair numbers at Kayankolam Bar in January 1903, noting that it was generally seen in pairs. An adult from Mangalore is in the Hume collection.

The Caspian Tern breeds in Ceylon in small numbers and Wait remarks (ed. ii, p. 381) that specimens from Ceylon are slightly smaller and have shorter bills than the typical form. I have only been able to examine one Cinghalese specimen and this appears to agree with the typical race, as do the three Presidency specimens which I have examined.

Gelochelidon nilotica nilotica (Gmelin).

Sterna nilotica Gmelin, Syst. Nat., vol. i (1789), pt. 2, p. 606—Egypt.

Not obtained by the Survey. The Gull-billed Tern is a winter visitor to the Presidency. Dewar says that it is very common at Madras and Ferguson found it fairly common about the backwaters of North Travancore and also frequenting the coast at Manakolam Bar.

Thalasseus bergii velox (Cretzschmar).

Sterna velox Cretzschmar, Atlas Reise Nörd. Afr., vol. ii (1827), tab. xiii, p. 21—Red Sea.

The Large Crested Tern is a sea tern and therefore is confined to the seaboard of the Presidency, around the whole of which it is doubtless found at one time or another. It breeds on islets off the northern coasts of Ceylon. Jerdon says that it is found on the Malabar coast and, as regards the Travancore seaboard, Ferguson found numbers at Kayankolam Bar and further north in January and December 1903.

Dewar includes it in his Madras list and there are five specimens with no very precise data from Madras—here probably meaning the neighbourhood of Madras Harbour—in the British Museum. I cannot trace the locality Viziadrug from which there is a male dated 7 April 1879 in the Hume collection.

I do not think that *Thalasseus bergii edwardsii* Mathews, *Birds of Australia,* vol. ii (1912), p. 347—Ceylon can be upheld. Birds from Ceylon and the Red Sea can be separated neither in colour or in size:—

	Bill.	Wing.	Central tail.	Outer tail.
3 adult ♂ Ceylon	70.5-73.5	340-352	83-85.5	152-191 mm.
4 adult ♂ Red Sea and Aden	71-74	343-358	88-102	160-182 mm.

With these the few Presidency specimens entirely agree.

Thalasseus bengalensis (Lesson).

Sterna bengalensis Lesson, Traité d'Orn. (1831), p. 621—India.

Not procured by the Survey. The Smaller Crested Tern is another seagoing species which may probably be found all round the coasts of the Presidency as a visitor out of the breeding season. There is an immature male without data from Nursapatam in the Hume collection. It occurs commonly about the backwaters and coast of Madras harbour (Jerdon) and also of the Travancore coast (Ferguson), but no further details of its status in the Presidency appear to be on record. The three specimens from Quilon (Bourdillon) in the British Museum are dated November.

On the coast of Ceylon this Tern is the most numerous species and may be observed apparently throughout the year.

I have kept the name binomial as there appears to be a good deal of doubt as to the distinctness of the supposed Australian race.

Sterna aurantia Gray.

Sterna aurantia Gray, Illustr. Ind. Zool., vol. i (25 January 1831), pl. 69, fig. 2—India.

In the *New Fauna* (iv, 126) Mr. Stuart Baker says that the Indian River Tern is found on all large rivers throughout India. This may be so but the *Old Fauna* was more guarded and stated that it was less common in the south of the Peninsula.

It is as well to emphasise, therefore, that I have found no definite record of this Tern in the Presidency, other than the specimen in the Madras Museum from Tada, Nellore district.

Sterna melanogaster Temminck.

Sterna melanogaster Temminck, Pl. Col., livr, 72 (1827), pl. 434—Island of Ceylon.

Specimen collected:—1196 ♂ 6-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Central tail.	Outer tail.	Tarsus.
1 ♂	41.5	226	67	144	18.5 mm.

In spite of Jerdon's statement that the Black-bellied Tern is common on every river in India we have not much information about its occurrence in the Presidency. The above specimen verifies La Personne's note that it was common on the Godavery in the Delta and Dewar includes its name without comment in his Madras list. Otherwise we have only Hume's remark (*S.F.*, x, 419) that he thought it occurred in the Wynaad, a suggestion as yet unverified. This handsome tern has no races.

[**Sterna hirundo** Linnaeus.

Sterna hirundo Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 137—Sweden.

Jerdon says that he obtained the Common Tern, on one occasion only, on the lake at Ootacamund and it is possible that the adult specimen from 'India' presented by Jerdon to the British Museum is really this specimen, though Hume discredited the record (*S.F.*, x, 418). Ferguson states that it is an occasional winter visitor to the coast of South Travancore, though he had not met with it at all in the north. His few specimens, he goes on to say, are immature. It does not appear that these specimens were ever examined and compared critically and I do not think therefore that this species should yet be definitely included in the Presidency list.]

Sterna repressa Hartert.

Sterna repressa Hartert, Nov. Zool., vol. xxiii (1916), p. 288—Persian Gulf.

Not procured by the Survey. Practically nothing is known about the status of the White-cheeked Tern on the Presidency coast. A female obtained on May 5th at Viziadroog, Malabar Coast—a locality which I cannot precisely identify—is in the Hume collection and the Madras Museum contains a specimen said to have been collected at Ennur in Chingleput.

I can find no authority for the statement in the *New Fauna* (vi, 128) that this Tern occurs in Ceylon, though it may well do so on occasion.

[**Sterna dougalli korustes** Hume.

Sterna korustes Hume, Stray Feathers, vol. ii (1874), p. 318—Andaman Islands.

Messrs. Inglis and Baker include this Tern in the *Birds of Southern India* on the grounds that it breeds in Ceylon and is sometimes seen off that coast in some numbers. This fact is true but there is as yet no actual record that would justify the inclusion of the Roseate Tern in the Presidency list.]

Sterna albifrons Vroeg.

Sterna albifrons Vroeg, Cat. d'Ois., Adumb. (1764), p. 6—Holland.

I have seen no specimens of the Little Tern from the Presidency and so cannot say anything about the subspecies which occurs there. According to Jerdon, the Little Tern is most abundant at the mouths of tidal rivers and backwaters on the Malabar coast and is more rare apparently on the east coast. Ferguson, however, can only mention a single specimen shot on the coast of North Travancore in January 1903, and Dewar includes the species without comment in his Madras list. Mr. H. L. Smith kindly informs me that he took two clutches of fresh eggs on a sand-bank at Masulipatam in April 1918 and found the species then fairly common.

Sterna anaetheta antarctica Lesson.

Sterna antarctica Lesson, Traité d'Orn. (1831), p. 621—Isle of France.

There are three specimens of the Brown-winged Tern in the British Museum which may be included in the Presidency list. These are an adult female in summer plumage taken at sea on 7 May 1876 sixty miles north of Madras (William Davison) and a male and female which 'fell on board off Cape Comorin 77°E. Lat. 8°N' on 26 September 1874 (Hume collection). These birds measure bill ♂ 48 ♀♀ 42, 44.5, wing ♂ 242 ♀♀ 245, 250 and in my opinion belong to the above race, though for lack of material I have not been able to revise the races of this Tern.

Rhynchops albicollis Swainson.

Rhynchops albicollis Swainson, Anim. in Menag. (1838), p. 360—India.

Not procured by the Survey. There is only one locality known to me for the Indian Skimmer in the Presidency. Colonel Sparrow informs me that he found it breeding at Bezwada in 1913 and the earliest date on which he saw young on the wing was 21 March.

Arenaria interpres interpres (Linnaeus).

Tringa interpres Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 148—Sweden.

The Turnstone is evidently a fairly common winter visitor to the shores of the Presidency. Mr. H. C. Smith informs me that he procured it at Masulipatam. Jerdon says that he procured it not uncommonly on the sea-coast near Madras and he doubtless provided the 'Madras' specimen which is in the Gould collection in the British Museum. Hume records it from Rameswaram Island in March (Hume, *S.F.*, iv, 459) and Cardew met with it on the Malabar coast (Baker & Inglis, p. 377).

Squatarola squatarola squatarola (Linnaeus).

Tringa squatarola Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 149—Sweden.

Jerdon says that he obtained the Grey Plover from the Madras market and there is an undated specimen (Wardlaw-Ramsay) and a male in remains of breeding plumage dated 1st September 1866 (Hume collection) from Madras in the British Museum.

For the western side Major Phythian-Adams informs me that he shot 7 from a flock of 25 Grey Plover in January 1933 at a place 14 miles north of Cannanore. This is the only occasion on which he has met with the species in South India.

Leucopolius alexandrinus alexandrinus (Linnaeus).

Charadrius alexandrinus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 150—Egypt.

Specimens collected:—1208 ♀ 1216 ♂ 9-1-30 Godaveri Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	18.5	110	47	29 mm.
1 ♀	19	110	47	26.5 mm.

In addition to the above two specimens collected by the Survey on the Godaveri Delta, Cardew is said to have met with the Kentish Plover at Bezwada (*Birds of S. India*, p. 379) and Dewar includes it in his Madras list without comment.

On the western side of the Presidency Ferguson states that it was fairly numerous at Neendakaray in Travancore in January.

The above two specimens undoubtedly belong to the typical race, but I may here remark that it is impossible to consider the birds which breed so numerously in Ceylon as the same subspecies. Seebohm pointed out years ago that Ceylon birds are very small—I measure: 3 ♂ bill 18-19.5, wing 103-104, tail 43-44, tarsus 25-27 mm.; 3 ♀ bill 17-20, wing 96.5-104, tail 39-43, tarsus 25-28.5 mm.—and proposed that they should be included with birds from the southern shores of the Red Sea under the name *Charadrius* *cantianus minutus* Seebohm, Geogr. Distrib. Charad. (1887), p. 169. This name was however preoccupied and Hartert and Jackson, *Ibis* 1915, p. 529 bestowed the name *Charadrius alexandrinus seebohmi*. Their restricted type locality Aripo, N. Ceylon cannot be accepted, as the correct type locality for *minutus* was Zulla and the name must therefore become a synonym of the typical race as recently pointed out by Captain C. H. B. Grant.[1] All three authors however overlooked what appears to be the most important difference of the Ceylon race that it does not acquire the chestnut cap of the breeding plumage of the typical race. This absence of a distinctive breeding plumage is a characteristic of other Cinghalese races and is of great interest. I therefore propose to mark it with the name

LEUCOPOLIUS ALEXANDRINUS LEGGEI subsp. nov.

Type:—♂ 27 June 1873, Hambantotta, S.-E. Coast, Coll. W. V. Legge, British Museum Register No. 96-7-1-545.

Differs from the typical race in its smaller size and in the fact that it does not assume the distinctive breeding plumage.

Haematopus ostralegus Linnaeus.

Haematopus ostralegus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 152—Oeland Island, Sweden.

Jerdon said that he had heard of the Oyster-catcher being procured at Mangalore and he considered it was far from rare near Tellicherry, thereby no doubt implying much the same status as on the Travancore coast where Ferguson calls it a more or less rare winter visitor, occurring generally in small flocks of half a dozen or so. It also occurs on the eastern coast of the Presidency as Dewar includes it in his Madras list and there is a local specimen in the Government Museum. I have seen no specimen and so cannot identify what race occurs in our area.

Elseyornis melanops (Vieillot).

Charadrius melanops Vieillot, Nouv. Dict. Hist. Nat., xxvii (1818), p. 139—Terres Australes.

In the *Madras Journ. Lit. Sci.*, vol. xxix (October 1840), p. 213, Jerdon described an apparently new species of Ring Plover under the name of *Charadrius russatus* and stated definitely that he procured it himself at the edge of the Pulicat Lake near Madras. The actual specimen is not at present traced but the description is full and clear and Jerdon particularly remarks on the maroon colour of the scapulars as a distinguishing feature. The species was not however new, having been described by Vieillot in 1818 and Jerdon's name was relegated to the synonym of this Australian bird. Its occurrence in Madras must however be accepted and the Australian Black-fronted Plover should be brought on to the Indian list though the record has been overlooked in both editions of the *Fauna*.

Charadrius dubius curonicus Gmelin.

Charadrius curonicus Gmelin, Syst. Nat., vol. i (1789), p. 692—Curonia = Courland, Latvia.

This western and northern race of the Little Ring-Plover is undoubtedly a winter visitor to the Presidency as I must attribute to it two immature and unsexed specimens (wings 119.5 and 121 mm.) from Coorg in the Tweeddale collection and also two unsexed adults from 'Madras' (wings 115 and 119.5 mm.) in the British Museum. The specimens collected by the Travancore survey also show that this form occurs in Travancore where Ferguson writes that he does not think the bird is a resident but that it comes very early to the coast. He had seen stragglers at Cape Comorin early in August and flocks might be seen as late as April. They are abundant in the dry rice fields after harvest and about the shores of tanks and beds of streams in the low country.

Major Phythian-Adams informs me that a flock of Little Ring-Plovers haunts the maidan near the Fort at Cannanore every cold weather and Hume

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[1] Bull. B.O.C., vol. lvii, p. 44, November 1906.

(*S.F.*, x, 412) said that he had records from Sultan's Battery, Wynaad and near the foot of the Coonoor Ghat. Jerdon says that he procured it from the top of the Eastern Ghats inland from Nellore. There is however no evidence regarding the race of these birds.

Charadrius dubius jerdoni (Legge).

Ægialitis jerdoni Legge, P.Z.S. 1880 (June 1st), p. 39—Ceylon.

Specimens collected:—1071 ♀ imm. 9-12-29 Cumbum Valley; 1209 ♀ 9-1-30, 1235 ♂ 12-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂ adult	15.5	109	57	23.5 mm.
1 ♀ adult	15.5	105.5	58	23 mm.
1 ♀ imm.	15.5	113	57.5	23 mm.

The above specimens collected by the Survey I attribute from their measurements to the resident race of Little Ring-Plover and to it presumably also belong the nests found by Colonel R. Sparrow with c/3 fresh eggs each at Bezwada on 20 March 1913 and 14 February 1914 and with c/3 eggs ready to hatch on 8 April 1913. At the same time I should like to point out that I have been unable to examine a series of breeding birds from Ceylon or India sufficient to establish the validity of this race. The only specimen examined from Ceylon (♂ imm.) has a wing of 118 mm.

Charadrius mongolus atrifrons Wagler.

Charadrius atrifrons Wagler, Isis (1829), col. 650—Bengal.

Jerdon states that he procured the Lesser Sand Plover in the Carnatic, at Madras and on the Malabar coast, and Ferguson in remarking that it is a winter visitor to the Travancore coast adds that it is sometimes found inland, a specimen being actually procured on the High Range at 6,000 ft. There are two 'Madras' specimens in the British Museum. I have no information about the dates of arrival and departure of this winter visitor but Mr. Van der Sleem collected a female on 7 September 1926 west of Parasala, Travancore, which is now in Mr. A. E. Jones' collection.

Charadrius leschenaultii Lesson.

Charadrius leschenaultii Lesson in Levrault's Dict. Sci. Nat., vol. xliii (1826), p. 36—Pondicherry.

The Greater Sand Plover is evidently less common than the lesser species on the Presidency coasts, though it is probably also a regular winter visitor. Jerdon states that he procured it on the east coast at Madras and Ferguson says that a single specimen was shot at Neendakaray near Quilon.

Pluvialis dominica fulva (Gmelin).

Charadrius fulvus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 687—Tahiti.

The Eastern Golden Plover is a fairly common winter visitor to the Presidency and it seems to be generally distributed in suitable localities. Major E. G. Phythian-Adams and Mr. R. F. Stoney have been kind enough to send me extracts from their shooting diaries and from these it is evident that the bird is far more common on the western side of the Presidency than on the east.

For the eastern side. I find that Mr. Stoney has killed a total of 97 Golden Plover (mostly in the Kistna, Chingleput and Madura districts) for the years 1899-1931. His two largest bags in a single day were 10 and 11 birds. While on the west, shooting only at Cannanore and that for strictly limited periods between 1925 and 1930, Major Phythian-Adams has a total of 180 Golden Plover, his biggest totals for a season being 22 (season 1929-1930), 40 (season 1931-1932), 47 (season 1932-1933) and 32 (season 1934-1935).

At the Chilka Lake, Annandale says that this species arrives about the middle of September and does not depart until May. Mr. Stoney's earliest date for Kistna district is 29 September (1905) and Major Phythian-Adams' for Cannanore is 21 September (1929), while Mr. H. C. Smith informs me that he met with the bird at Masulipatam on 16 April 1918. A specimen in the Hume collection from Narainan, Madras, is dated 25 August 1866. The breeding plumage is assumed before the bird leaves South India and this fact, together with the late date on which the last stragglers may be found, misled Jerdon into the assumption that the Golden Plover bred at Nellore. Hume records it at Rameswaram Island in March (*S.F.*, iv, 459).

On the west coast, the Golden Plover is, as indicated above, numerous at Cannanore. Further south Ferguson says that flocks may be commonly met in North and Central Travancore, about Cherayankie, Parur and Vycomb frequenting swampy flats and paddy fields.

No specimens were procured by the Survey.

Chettusia gregaria (Pallas).

Charadrius gregarius Pallas, Reise Russ. Reichs, vol. i (1771), p. 456—Volga.

There is only one record of the Sociable Plover in the Presidency as its normal winter range does not extend so far south. Ferguson records how he shot two birds from a flock of five that were feeding in some paddy fields at Trivandrum in January 1900. Their appearance was no doubt due to the failure of the rains in Northern India in 1899 which resulted in a famine.

Lobivanellus indicus indicus (Boddaert).

Tringa indica Boddaert, Table Pl. Enlum. (1783), p. 50 on Pl. Enl. 807—Goa, India.

Specimens collected:—92 ♀ 19-4-29 Kurumbapatti; 1245 o? 13-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♀	33	208	108	70 mm.
1 sex?	36.5	213	111	74 mm.

The Red-wattled Lapwing seems to be found more or less generally throughout the Presidency but I do not find any actual record from north of the Godavery Delta. There are specimens from Annappukolam, Nellore district, in the Madras Museum and Dewar calls this bird very common at Madras. The Survey also found them at Kurumbapatti and, rather more commonly, about Salem town.

On the west, Ferguson says that the Red-wattled Lapwing is common in the low country all over Travancore and Terry heard it calling at night at Pittur in the Palnis. Further north Betts calls it common in Coorg and Davison says that it is not uncommon in the Wynaad. From here it ascends the Nilgiris in small numbers, a few pairs even breeding on the plateau. In Southern India this plover is strictly resident and Betts remarks to me that each pair may be found inhabiting the same stretch of country for years together.

The breeding season in the Nilgiris is said to be in April and May (Miss Cockburn) and Ferguson gives it as March in Travancore.

I do not myself see much use in maintaining the race *aigneri* for this species. After examining a large number of birds from Ceylon to Afghanistan and Mesopotamia I find that though there is a slight average increase in size from Ceylon to the north-west, accompanied by a very slight paling of colour, it is accompanied by so much individual variation that it is quite impossible to define any recognisable limits for two races *indicus* and *aigneri*. Ticehurst was inclined to maintain the two races on the amount of gloss (*Ibis* 1923, p. 665) but this does not seem to me a good character either.

Lobipluvia malabarica (Boddaert).

Charadrius malabaricus Boddaert, Tabl. Pl. Enlum. (1783), p. 53 for Pl. Enl., 880—Malabar.

Specimens collected:—455 ♀ 21-6-29 Tirthamalai 1,000 ft.; 660 sex? 6-8-29 Palkonda Hills 1,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♀	27.5	190.5	70.5	56.5 mm.
1 sex?	29	193	76	59 mm.

There appears to be no actual record of the Yellow-wattled Lapwing in the Presidency from anywhere north of the Palkonda Hills where it was procured by the Survey. Dewar says that it is very common about Madras and the Survey also obtained it at Tirthamalai.

In Travancore, it is common (Ferguson, Stewart). From further north on this side I have seen specimens from Malappuram (Sparrow coll.: ♂ 7-6-1912), from the neighbourhood of Segore (Sigur ♀ 22-2-81, William Davison) and Sultan's Battery, Wynaad (♀ 31-1-83, William Davison).

In Travancore, Bourdillon found them breeding from 3 March to 13 August and Stewart from 4 April to 6 August (Stuart Baker, *Nidification*, iv, 402). Under this reference and in our *Journal*, xxxv, p. 250, Mr. Stuart Baker has a good deal to say about an erythristic type of egg found on an outcrop of red laterite soil in Travancore.

I have only seen one specimen, and that a juvenile, of the Yellow-wattled Plover from Ceylon. On the mainland there is perhaps a slight increase in size from south to north, and birds from Travancore appear slightly richer in colour than those of the Peninsula generally. The material available from the south is not however very good and at present I am not satisfied that the recognition of any races is justified.

[**Recurvirostra avosetta** Linnaeus.

Recurvirostra avosetta Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 151—South Europe.

Dewar includes the Avocet in his Madras list without any comment but I have seen no evidence that it has ever been found in the Presidency, beyond Jerdon's statement (*Madras Jour. Lit. Sci.* 1840, p. 209, that he had seen stuffed specimens killed as far south as Madras. Further evidence is required before the avocet can be admitted to the Presidency list.]

Himantopus himantopus (Linnaeus).

Charadrius himantopus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 151—Southern Europe.

There is a local specimen of the Black-winged Stilt in the Madras Museum and this is doubtless Dewar's warrant for the inclusion of the species in his list. I know of no other record for the Presidency.

Numenius arquata (Linnaeus).

Scolopax arquata Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 145—Sweden, Europe.

The Curlew is doubtless found around the whole coast of the Presidency as a winter visitor. In Travancore, Ferguson says that it is found only on the coast, but not in any great numbers. At Madras, Dewar says that it occurs in considerable numbers in all places where there is shallow salt water. I have seen no specimen from the Presidency but the race that occurs will prove no doubt to be *N. a. orientalis* Brehm.

Numenius phaeopus phaeopus (Linnaeus).

Scolopax phaeopus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 146—Sweden.

Jerdon says (*Madras Jour. Lit. Sci.* 1840, p. 212) that he saw the Whimbrel in considerable numbers at the Chilka Lake and that he had also seen it on the seacoast near Madras. There is a Madras specimen in the Hume collection dated 1 September 1866. Hume records it from Rameswaram Island in March (*S.F.*, iv, 459).

On the western side Colonel H. R. Baker (*Birds of S. India,* p. 392) says that it is one of the earliest winter visitors to arrive. He first noticed their arrival near Cannanore on 5 August 1910 and shot a couple on the 25th of that month.

In Travancore Ferguson says that it may be found in suitable places along the coast in fair numbers from October to April.

[**Limosa limosa** (Linnaeus).

Scolopax limosa Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 147—Sweden.

The Black-tailed Godwit is included by Dewar in his list without comment. This species is however so very rare in Central and Southern India that it cannot be included in the Presidency list until a more positive record is forthcoming.]

Limnodromus semipalmatus (Blyth).

Macrorhamphus semipalmatus Blyth, J.A.S.B., vol. xvii (1848), p. 251—Madras.

The claim of the Snipe-billed Godwit to a place on the Presidency list is based solely on the specimen which Jerdon procured in the Madras market about the close of 1844 and which was the type of the species.

Terekia cinerea (Güldenstadt).

Scolopax cinerea Güldenstadt, Nov. Comm. Acad. Sci. Imp. Petrop., vol. xix (1774), p. 473, pl. 19—Terek River.

The Terek Sandpiper is included in his list by Dewar without any comment, but Major Phythian-Adams kindly informs me that he shot two from a flock at Cannanore on 12 December 1931. Jerdon says (*Madras Jour. Lit. Sci.*, 1840, p. 208) that he only met with it on one occasion, at the edge of the Trichoor Lake.

Tringa ochropus (Linnaeus).

Tringa ocrophus (sic) Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 149—Sweden.

Specimens collected:—807 ♂ 11-9-29 Kodur; 1085 ♀ 11-12-29, 1136 ♀ 18-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	37.5	130	53	33.5 mm.
2 ♀	39-40	143-149	61-63	33-35 mm.

The Green Sandpiper is of course a winter visitor to the Presidency but it is there far less common than in Northern India. On the eastern side, the only record that I have traced, in addition to the three Survey specimens, is a specimen from Chingleput in the Madras Museum. In Coorg, according to Betts, it is not uncommon, arriving fairly early (first seen on September 30, 1928) and staying late, often lingering well on into May. There are two specimens from the Nilgiris in the British Museum, shot in April by William Davison, but these must have been collected after his paper in *Stray Feathers* in which he states that a specimen shot some years previously on the bank of the lake at Ootacamund was the only one that he had seen in Southern India.

Terry says that he shot one on May 4th in the Pittur Valley but a specimen collected by Terry in the Palnis and now in the British Museum is dated April 3rd. In Travancore Ferguson considered it as not nearly so common as *T. glareola* and he mentions one shot in a swamp on the High Range at 6,000 ft. in January.

Tringa stagnatilis (Bechstein).

Totanus stagnatilis Bechstein, Orn. Taschenb., vol. ii (1803), p. 292—Germany.

There is a specimen of the Marsh Sandpiper from Calicut in the Tweeddale collection in the British Museum and Jerdon states that he saw it in large flocks on the banks of the Trichoor Lake. Further south in Travancore Ferguson's collectors met with flocks on the seashore at Manakodam Bar and at North Parur. They were in company with Greenshanks.

On the eastern side Dewar includes the species in his Madras list, doubtless on the evidence of the local specimen in the Madras Museum. Another Madras specimen dated December 11th is in the Tweeddale collection. The bird is of course a winter visitor to the Presidency.

Tringa hypoleucos Linnaeus.

Tringa hypoleucos Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 149—Sweden.

Specimen collected:—806 ♀ 11-9-29 Kodur.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♀	26	111	57.5	24 mm.

The Common Sandpiper is no doubt common and very generally distributed throughout the Presidency, though on the eastern side, we have no other information beyond the Survey specimen and Dewar's statement that it is very abundant about Madras. His belief that it is a resident is of course incorrect. The Common Sandpiper is a winter visitor to India south of the Himalayas but a certain number of non-breeding individuals may be met throughout the summer months in their winter quarters.

In Travancore Ferguson calls it one of the most widely spread of birds, common in the paddy fields everywhere from September to May. William Davison also considered it common in the Nilgiris. There is a specimen from Mangalore (24 April, Dr. Day) in the Hume collection.

Tringa glareola Linnaeus.

Tringa glareola Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 149—Sweden.

Specimen collected:—1135 ♀ 18-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♀	31.5	124	47	35 mm.

The Wood Sandpiper is a common winter visitor and passage migrant on its way to Ceylon in the western side of the Presidency. William Davison says that in the Nilgiris he has seen specimens about the ponds in the Botanical Gardens at Ootacamund as late as July, though these, I suggest, may have been non-breeding birds which had not migrated to their summer quarters. In Travancore Ferguson considered it the commonest of the Sandpipers, to be found in abundance in the wet paddy fields from August to May.

On the eastern side we have no particular information about it, the Survey specimen and Dewar's inclusion of it in his Madras list being the only published records.

Tringa totanus (Linnaeus).

Scolopax totanus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 145—Sweden.

The Common Redshank has been very seldom recorded in the Presidency where it is, of course, a winter visitor. Major Pythian-Adams informs me that it is not uncommon about Cannanore. Ferguson's collectors secured one at Neendakaray in January 1903. There is a local specimen in the Madras Museum and Mr. H. C. Smith informs me that he shot one at Masulipatam on 16 April 1918. No specimen has been critically examined for racial identification.

Tringa erythropus (Vroeg).

Scolopax erythropus Vroeg, Cat. d'Ois, Adumb. (1764), p. 6—Holland.

The Spotted Redshank must occur in the Presidency as the British Museum possesses a 'Madras' skin from Jerdon and another from Chingleput in the

Hume collection. Both are in breeding plumage. I can find no other information regarding it in our area.

Tringa nebularia (Gunnerus).

Scolopax nebularia Gunnerus in Leem's Beskr. Finmark. Lapp. (1767), p. 251, note—Norway.

Major Phythian-Adams informs me that the Greenshank is not uncommon round Cannanore in the cold weather. Hume stated (*S.F.*, x, 414) that he had received it from the Wynaad. Kinloch saw a solitary bird by the Manalora stream in the Nelliampathies. Ferguson says that he had never met with the Greenshank in Southern Travancore but that in the north his collectors met with flocks and obtained specimens at Yettamanna, Shertally and Vycombe. There is, however, a male collected by Bourdillon at Quilon on February 25 in the British Museum.

On the eastern side it is recorded only from Madras, in Dewar's list.

Philomachus pugnax (Linnaeus).

Tringa pugnax Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 148—Sweden.

The Ruff and Reeve have so far only been recorded in the Presidency from the neighbourhood of Madras. In the British Museum there is a female in the Tweeddale collection collected at Madras by Wardlaw-Ramsay on December 2nd. The Madras Museum contains specimens collected at Madras and at Vandalur, Chingleput district. It is of course a winter visitor.

Crocethia alba (Vroeg).

Tringa alba Vroeg, Cat. d'Ois. Adumb. (1764), p. 7—Coast of North Sea, Holland.

Jerdon states (*B. of I.*, iii, p. 694) that he obtained the Sanderling on the coast at Nellore where it appeared to be tolerably abundant. There is a local speicmen in the Madras Museum. It must of course be a winter visitor.

Erolia minuta minuta (Leisler).

Tringa minuta Leisler, Nach. zu Bechst. Nat. Deutsch. (1812), p. 34—Germany.

Specimen collected:—1210 ♀ 9-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♀	22	101	42	22.5 mm.

The Little Stint is a winter visitor to the Presidency and before the Survey obtained the above specimen it had already been recorded on the eastern side by Dewar in his Madras list. On the west Hume says (*S.F.*, x, 414) that he had himself seen it below the Coonoor Ghat and Ferguson recorded it as a fairly common winter visitor to the coast of North Travancore.

Erolia temminckii (Leisler).

Tringa temminckii Leisler, Nacht. zu Bechst. Nat. Deutsch. (1812), p. 63—Germany.

Specimen collected:—1234 ♂ 12-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	17.5	95	48	16.5 mm.

The above Survey specimen appears to provide the first explicit record of Temminck's Stint for the Presidency, with the exception of Dewar's inclusion of the species in his Madras list without comment.

Erolia testacea (Pallas).

Scolopax testacea Pallas in Vroeg's Cat. d'Ois. Adum. (1764), p. 6—Holland.

According to Ferguson, the Curlew-Sandpiper is found from October to April on the coast of North Travancore, especially by Manakodam Bar. It is apparently also fairly common on the eastern coast as Mr. H. A. Smith informs me that he shot one at Masulipatam on 16 April 1918, Dewar includes it in his Madras list, there is a local specimen in the Madras Museum and a pair of adults collected by Wardlaw-Ramsay at Madras in December are in the Tweeddale collection in the British Museum.

[**Calidris tenuirostris** (Horsfield).

Totanus tenuirostris Horsfield, Trans. Linn. Soc., vol. xiii, (May 1821), p. 192—Java.

Dewar's inclusion of the Eastern Knot in his Madras list is probably based on Jerdon's record of obtaining a Knot *Tringa canutus* at Madras (*B. of I.*, iii, 689), a record which is usually considered to refer to this species.]

Limicola falcinella (Pontoppidan).

Scolopax falcinellus Pontoppidan, Danske Atlas, vol. i (1763), p. 623—Denmark.

Very little is known about the occurrence of the Broad-billed Sandpiper in the Presidency but Ferguson states that a single specimen was shot by his collectors at Manakodam Bar in Travancore in January 1903. Three unsexed specimens, two in winter plumage and one in worn breeding dress, labelled 'Madras' are in the British Museum. One of these is dated April 1876.

Lobipes lobatus (Linnaeus).

Tringa lobata Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 148—Hudson Bay, America.

The Red-necked Phalarope is said in the *Old Fauna* (iv, 282) to occur on the west coast of India and on the east coast as far north as Madras where, at times, it is not uncommon. I have not found the source of this statement but Jerdon said he had a single record for India, namely a bird obtained by Dr. Stewart at Madras (*B. of I.*, iii, 696) and the British Museum possesses three specimens from 'Madras' dated September-October in the Hume collection. There is also a local specimen in the Madras Museum.

Scolopax rusticola Linnaeus.

Scolopax rusticola Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 146—Sweden.

The Woodcock was not obtained by the Survey but it is well known as a winter visitor to the hills of the Presidency and more particular to the western side, where it is naturally best known as a sporting bird in the Nilgiris.

On the west Jerdon says that it is found in Coorg and A. G. Theobald records (*apud* Hume & Marshall, iii, 311) that he has heard of their being shot in the Wynaad.

Regarding the Nilgiris there is a good deal on record. For these hills Captain Lambton (*J.B.N.H.S.*, xx, 854) on the authority of the Hadfields *père et fils* gives the season as follows:—Woodcock invariably arrive on the Nilgiris during the month of October and never has this month gone by without a bird being bagged. The 9th October is the earliest date on which the first bird was seen and killed but the third week in October is generally the earliest that the first cock is accounted for. The October flight is as a rule very small and the birds that put in an appearance can be numbered on the fingers of one hand.

December and January are the months when cock drop in larger numbers and by the end of March there is not a bird to come across.

William Davison (*apud* Hume & Marshall, iii, 310) would perhaps consider the season a little shorter. They come in late in October, or early in November, he says, and depart again at the latest by the end of February. Col. Baker (*J.B.N.H.S.*, xxix, 564) puts their arrival in the first week of November and Major Phythian-Adams (*J.B.N.H.S.*, xxxii, 607) considers February the best month for Woodcock and adds that nearly all are gone by March 15th or earlier if heavy rain falls. Major Logan Home (*J.B.N.H.S.*, xxix, 841) mentions an exceptionally late bird flushed on the Krurmand Mukerti Peak track on 28 April 1923. The male dated 25 May Ootacamund (W. Davison) in the Hume collection was doubtless a pricked bird.

As regards the number of Woodcock that visit the Nilgiris the general and I fear correct idea is that they are decreasing. Captain Lambton was informed that in the early 'sixties' of the last century a single gun was known to have bagged 250 cock during one season. This, if not exaggerated, was surely an exceptional case and not to be compared with the 30 or 40 birds which Capt. Lambton considered a good season's bag about 1910. He goes on to say that the largest bag made by two guns within the last 35 years in one day was 7 couple, all the birds flushed being accounted for, while 3 or 4 Woodcock are the normal number to be obtained in a day's shooting. These figures should be compared with Jerdon's statement, made as a matter of course and no doubt representing the normal sport of the 'fifties and sixties' that he had himself killed 8 in a forenoon and had known 16 and 20 killed by two or three guns.

In 1921 Colonel H. R. Baker writes (*loc. cit.*):—'Now a single gun is lucky, as I have been, if he gets 30-40 cock in a season and 6 in a day. In 1920-21 I got 35 and in 1921-22 I got 29 and in both seasons my best bag was 6 in a day out of 7 seen.'

In 1927 (*J.B.N.H.S.*, xxxii, 607) Major Phythian-Adams considers 25-30 Woodcock a good average season's bag, it being remembered that small game shooting on the plateau is now limited to two days a week. He has kindly given me the figures for his own shooting for the seasons from 1923 to 1930 and the number per season varies from 12 to 27.

A note on weights will be found in our *Journal* in vol. xx, 1154, and a good account of a typical day's shooting by Col. H. R. Baker will be found in vol. xxviii, 434-38.

Leaving the Nilgiris, Theobald says that he has shot Woodcock in the Anamallais and in the Burghoor and Husinoor Hills of the Coimbatore district. Fairbank says that they are certainly rare in the Palni Hills but that he himself flushed one in the Kodaikanal in 1867 and that afterwards one was shot by a Mr. Levinge.

In the Nelliampathies, Kinloch says it is very rare but I cannot make out whether his idea that it dropped in on passage at the end of September and beginning of October and again early in March is theory or based on observation. It seems at variance with what we know of the bird in the rest of the area.

In Travancore, according to Ferguson, occasional Woodcock may be met in grass land bordered by forest in South Travancore at about 4,000 ft. in the winter. On the High Range, he adds, it used to be fairly common at this period in similar localities, before the forest was cut down for coffee and tea. Bourdillon considered it pretty common in the Assambo Hills, but only at the highest elevations from November to March.

On the eastern side of the Presidency there is far less information. Ball states (*S.F.*, v, 419) that he was assured by a Mr. Blaxland that Woodcock had been several times seen and on one occasion shot on the higher plateaux of Jeypore. One was shot by Mr. L. T. Harris, I.C.S., at Salabam 4,000 ft. on 26 February 1915 (*J.B.N.H.S.*, xxiii, 777). Jerdon says that he knew of it having been procured at Masulipatam and at least once found in the Madras market.

There is a specimen from the Shevaroys in the Madras Museum and, finally, Theobald informs us that he had shot Woodcock on the Shevaroys and Javadi Hills of the Salem district.

Capella nemoricola (Hodgson).

Gallinago nemoricola Hodgson, P.Z.S. 1836 (April 9), p. 8—Nepal.

The Wood Snipe was recorded by Colonel McMaster at Russelconda in Gumsoor (Hume & Marshall, iii, 326) where he obtained two. It has not been otherwise recorded on the eastern side of the Presidency north of the Shevaroy Hills where it was shot by Albert Theobald (Hume & Marshall, iii, 326) and H. R. P. Carter on December 28 (specimen in British Museum).

On the western side, it is of course far better known. It is usually met with in the hills but Major E. G. Phythian-Adams shot one about 12 miles north of Cannanore on 27 November 1933 (*J.B.N.H.S.*, xxxvii, 220). It is found in Coorg (Hume & Marshall, iii, 326) and in the Wynaad where J. W. Ditmas records (*S.F.*, x, 173) that he saw 7 Woodsnipe in 18 years' residence and bagged three of them. Phythian-Adams considers that the bird is probably commoner in the Wynaad than in the Nilgiris (*J.B.N.H.S.*, xxxii, 606).

'On the Nilgiris', says William Davison (*S.F.*, x, 413), 'it was never common and seems to be getting still more rare, year by year, and though when on the Nilgiris last I had offered all the native shikaris a large price for any specimens they could procure me, I failed to get any'. I doubt, however, whether Davison is correct in thinking the bird any rarer than it always has been. Colonel H. R. Baker shot 5 in February and March 1922 (*J.B.N.H.S.*, xxix, 564) of which 2 males are now in my collection. Major Phythian-Adams has kindly given me details of 6 birds shot by him, viz.:—one on 2 January 1924, two on 29 January 1927, and one on each date 2 January 1928, 16 February and 29 October 1929. Mr. R. F. Stoney has also been good enough to tell me that he shot single birds on 3 December 1933 and 15 February 1935.

Albert Theobald (*loc. cit.*) shot the Woodsnipe in the Guddasal Hills of the Coimbatore district, in the Annamalais and in the Palnis. In Travancore its occurrence rests on a single bird shot in the High Range and in the Trivandrum Museum when Ferguson wrote (*J.B.N.H.S.*, xvi, 10).

I have little doubt that the Woodsnipe is merely a winter visitor to the Presidency and it has been recorded every month from 29 October to the 6th March.

Capella solitaria (Hodgson).

Gallinago solitaria Hodgson, Glean. Sci., vol. iii (August 1831), p. 238—Nepal Terai.

The solitary Snipe may perhaps just come into the Presidency list in virtue of its occurrence on the Chilka Lake. Mr. H. B. Tilden killed one at Nalban Island on 16 December 1921. It was identified by Mr. T. McDonnell of Calcutta who informed him that several had been flushed in the same locality by Mr. James Smythe of Calcutta at Christmas 1920 (*J.B.N.H.S.*, xxviii, 1133).

This record may be correct but I feel by no means satisfied with the identity of the specimen said to have been shot near Davala, S.-E. Wynaad, in 1898 by Mr. F. W. F. Fletcher and Mr. W. Hamilton (Stuart Baker, *Game Birds*, ii, 39).

Capella gallinago gallinago (Linnaeus).

Scolopax gallinago Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 147—Sweden.

In the Madras Presidency, the Fantail Snipe is definitely less numerous than the Pintail and it is not quite so generally distributed. Unfortunately the recorded evidence is not sufficient to enable me to write a very satisfactory account of the species.

In the north-east of our area, there is not apparently a very great disproportion between the numbers of the two species. In fact, about the Chilka Lake and Ganjam, it is possible that the Fantail is actually the more numerous. But as one works southwards the Pintail is found to be more and more numerous compared with the Fantail and this is also the case along the western side of the Presidency, as shown by the comparative totals cited in the account of the Pintail. In the Nilgiris, or at least at higher elevations, the Fantail does not normally occur, and I have no record of it at all for the Travancore Hills or Eastern Ghats. Terry and Fairbank both, however, record it in the Palnis, though the elevation is not given. In Ceylon it is of course a rare straggler.

The times of arrival and departure are, for lack of exact evidence, hard to define. In any case they evidently vary a good deal from year to year; being no doubt largely dependent on existing conditions in the more northern portions of the bird's range, particularly in Northern India, which in turn depend on the rainfall.

I have not traced any actual records for this species in the Presidency in August. There are a few records of the first Fantails being found in September as follows:—Coorg 14 September 1908, 18 September 1909 (Major J. C. Macrae); Cannanore 21 September 1929 (Major E. G. Phythian-Adams); Chingleput 28 September 1902, 11 September 1904 (R. F. Stoney); Madura 27 September 1903 (R. F. Stoney). The majority however do not appear until October or November and leave by the beginning of March though some may be found throughout the month. There are a few April records:—Palnis 3 April (Terry); Quilon 21 April (Giles, *J.B.N.H.S.*, xix, 749); Madura 6 April 1902, 5 April 1903, 13 April 1904 (R. F. Stoney). Birds seen on 4 May, Palnis (Terry), Palamcottah in April and May and at Vellore Railway Station (Theobald, Hume & Marshall, iii, 362) in May and June are said to have belonged to this species. As the Vellore and Palamcottah birds are said to have been in very poor condition and scarcely able to fly they may be disregarded as their late stay was doubtless due to shot wounds.

Mr. Stuart Baker (*Game Birds*, ii, p. 63) gives a map of the migration routes of this species, showing an orderly progress from north to south. It is well to remember that this map is merely a picture of what the author considers may occur, for existing records, which I have collated carefully, do not justify any such deductions. My own impression is, morever, that the Snipe arrive in a much more haphazard manner and that for Southern India the dates given are far too early. This species does not apparently reach Ceylon before December.

Capella media (Latham).

Scolopax media Latham, Gen. Synops. Birds, Suppl., vol. i (1787), p. 292—England.

It is somewhat curious that all three records of the Great Snipe in India refer to one small area of S.-E. India in places more or less in one straight line. Two of these are in the Presidency. The first specimen was obtained by Capt. C. Donovan, M.B.O.U., at Madras on 5 September 1899 under circumstances detailed in full in *J.B.N.H.S.*, xii, p. 782. The other was shot by Mr. G. L. Peters near Arkonam, N. Arcot district, on 30 March 1913 (Kinnear, *J.B.N.H.S.*, xxii, 631). This is not far distant from Bangalore where the third Indian specimen was shot by Capt. A. Boxwell on 28 October 1910 (*J.B.N.H.S.*, xx, 1155).

Capella stenura (Bonaparte).

Scolopax stenura Bonaparte, Ann. Stor. Nat. Bologna, vol. iv (1830), p. 335—Sunda Island.

The Pintail Snipe is quite easily the most abundant and the most generally distributed of the Game birds of the Presidency and there is therefore no need to give in full the various records that I have accumulated on its occurrence. On the eastern side of the Presidency it may be found and shot all along the coastal plains from the Chilka Lake through Ganjam, Vizagapatam, the Northern Sircars, the Godavery and Kistna rivers, Nellore, Madras, Chittoor, N. and S. Arcot, Chingleput, Tanjore to Madura, though on this side I have found no record whatsoever of its occurrence on the Ghats. On the western side it is similarly found throughout the suitable areas of the low ground from Cannanore to Travancore, extending also into the hills through Coorg and the Wynaad to the Nilgiris where it is found up on the plateau, to the Palnis and to the higher hills of Travancore, though here it appears to be scarce at more than moderate elevations.

The Pintail Snipe is chiefly a winter visitor to the Presidency though of course a large number of birds must drop in temporarily on passage on their way to and from Ceylon.

The earliest date on which I have any exact record of this Snipe in the Presidency is 27 August 1904 when Mr. Stoney shot one in Chingleput but Davison says that he has known it come in in the last week in August in the Nilgiris. The first arrivals may however usually be expected in September. I have accumulated the following records for September:—Cannanore 24 September 1927, 21 September 1929 (Phythian-Adams); Coorg 9 September 1932, 9 September 1934 (Betts); Nilgiris 28 September 1925, 23 September 1926, 21 September 1933 (Phythian-Adams); 20 September 1931, 5 September 1932 (Stoney); Kistna 9 September 1905, 20 September 1923 (Stoney); Chingleput 15 September 1901, 21 September 1902, 28 September 1912, 20 September 1914 (Stoney); Tanjore 6 September 1908, 3 September 1909 (Stoney); and finally Madura 22 September 1901, 13 September 1903, 22 September 1914, 24 September 1916 (Stoney). Ferguson also says that a few stragglers arrive early in September in Travancore. The main body however do not come until considerably later probably towards the end of October or November, but it must be remembered that Snipe are far from regular in their movements which depend on the season and particularly the amount of water or drought not only in the Presidency but in other areas further north. They leave again in March though a few birds linger on into April and I have the following records for May:—Wynaad 5 May (Davison); Nilgiri Plateau 4 May (Phythian-Adams), 2 May 1922 (Limornin).

Mr. Stuart Baker (*Game Birds*, ii, p. 97) gives a map of the approximate dates on which the earliest examples (p. 95) of this species arrive at their respective destinations. This shows a regular progress southwards and westwards as if the birds travelled in regular stages and according to this map the terminal arrivals are Sindh 30 October and Ceylon 25 October and 1 November. Unfortunately for this map, Ticehurst has shown that in Sindh around Karachi he met with it on 11 September 1918 and 4 September 1919 (*Ibis* 1924, p. 133) while in Ceylon, according to Legge, it arrives in September, either early or late according to season. In that island, Butler's earliest date for it was August 31 (*J.B.N.H.S.,* x, 313). My own impression is that the Pintail Snipe does not arrive in the orderly progress suggested by the map but that it drops in more or less simultaneously in many widely spread localities. The earliest dates for the Peninsula in the map are at any rate evidently a month too late.

The Pintail Snipe is far more abundant in the Presidency than the Fantail both on the east and on the west. Wall gave an interesting summary of his shooting at Cannanore in the season 1903-1904 (*J.B.N.H.S.*, xv, 722). This shows a total of 354 Pintails as against 73 Fantails. Major Phythian-Adams has kindly given me his Snipe tables for Cannanore for the 10 seasons 1925-26 to 1934-35. 3,644 Pintails were killed in comparison with 856 Fantails. For the 12 seasons 1923-24 to 1934-35 on the Nilgiri Plateau 526 Pintails were killed and only one Fantail by the same sportsman.

Mr. R. F. Stoney has also been good enough to send me his Snipe tables for the Presidency for the 37 seasons from 1898-99 to 1934-35. These show a total of 13,530 Pintails and 2,312 Fantails for the whole period. The following are the more important district totals:—Nilgiris 383 Pintails and no Fantails; Coimbatore 121 Pintails, 6 Fantails; Madura 6,409 Pintails, 700 Fantails; Tanjore 331 Pintails, 110 Fantails; S. Arcot 259 Pintails, 99 Fantails; Chingleput 5,875 Pintails, 1,233 Fantails. These figures all show beyond question that in the main area of the Presidency the Pintail predominates very largely. In the north-eastern area this is doubtless not the case and it is interesting to note that Mr. Stoney's totals for this area, though not large, show very different proportions:—Nellore 25 Pintails, 55 Fantails; Kistna 89 Pintails, 63 Fantails; and Ganjam 20 Pintails, 35 Fantails.

Interesting notes by Mr. Stoney on the weight of Pintail and Fantail Snipe in the Presidency will be found in the *Journal* (xxiii, 778; xxv, 306).

Capella megala (Swinhoe).

Gallinago megala Swinhoe, Ibis 1861, p. 343—Amoy.

When Mr. Stuart Baker wrote his first account of Swinhoe's Snipe (*J.B.N.H.S.*, xx, 595) only two records of the species were known in the area covered by the *Fauna of British India,* namely from Dibrughar and the Shan States.

It was first identified in the Presidency in the shooting season of 1911-12. Mr. R. F. Stoney shot one in Chingleput on 3 December and one at Tindivanum on 3 March. Mr. Graham Ross shot one and Mr. I. S. Fraser shot three in the Chingleput district (*J.B.N.H.S.,* xxi, 1083). Since then Mr. Stoney kindly informs me that he has shot one in Chingleput on 30 September 1914, another in Madura on 29 November 1914 and a third in Madura on 3 November 1915.

On the western side about Cannanore, Major E. G. Phythian-Adams has killed 15 in the 10 shooting seasons from 1925-26 to 1934-35. Of this one was shot on 21 September, 4 in November, 5 in December, 2 in January and 3 in February, the latest date being 22 February. Some of these were mentioned in *J.B.N.H.S.,* xxxii, 606.

We are, I think, now entitled to assume that it is a regular winter visitor to the Presidency in small numbers, occurring from September to March and somewhat generally distributed.

There are no specimens of Swinhoe's Snipe in the British Museum from Southern India but Major Phythian-Adams kindly sent me the two birds shot in 1935.

Lymnocryptes minimus (Brünnich).

Scolopax minima Brünnich, Orn. Bor. (1764), p. 49—Europe.

The Jack Snipe is a well-known winter visitor to the Presidency though it is never found in the large numbers of the Pintail and Fantail Snipes. I have traced no actual record of it in the north-east corner of the Presidency above the Kistna river and it is evidently scarce or absent in the hills. Otherwise it is so generally distributed that there appears to be no need to cite the records in full. Nellore, Madras, Chingleput, S. Arcot and Madura all contain much good snipe ground and Mr. R. F. Stoney's game books shew in these districts between 1898 and 1935 a total of 126 Jack Snipe killed.

On the western side Major Wall's bag for the 1903-1904 season at Cannanore shows 1 Jack Snipe out of a total of 465 head (*J.B.N.H.S.*, xv, 722). Major Phythian-Adams' record for this area for the 10 seasons 1925-35 shows a total of 58 Jack Snipe. They are doubtless similarly distributed through the rest of the low ground as near Nellamboor and Wondoor and in parts of Palghat and South Travancore (Hume & Marshall, iii, p. 375). A few birds mount on to the Nilgiris and Palnis but Major Phythian-Adams has only killed 2 on the Nilgiri plateau in the 12 seasons 1923-24 to 1934-35.

Bourdillon (*loc. cit.*) gives the stay of the Jack Snipe in South Travancore as from September to April, or the early part of May but this appears much exaggerated. A. Theobald, on the other hand, says that they come in about the end of November and leave again before the end of February. This is certainly a more correct estimate of the normal movements though Mr. Stoney's notes show 3 November and 9 November and 8 March and 10 March as early and late dates for the species.

(*To be continued*).

THE BIRDS OF BOMBAY AND SALSETTE.

BY

SALIM ALI and HUMAYUN ABDULALI.

Part II was not received in time for inclusion in this number. It will appear in the next issue.

THE SNAKES OF DEOLALI.

WITH NOTES ON THEIR COMPARATIVE OSTEOLOGY AND PECULIARITIES OF DENTITION.

BY

A. G. L. FRASER, I.M.D.

(*With 3 plates and 1 text-figure*).

PART II.

(*Continued from page 82 of this volume*).

VARIATIONS IN THE OSTEOLOGY OF THE SNAKE.

At the outset it may be remarked, that the various bones which enter into the formation of the endoskeleton, show marked specific differences in size, formation and shape, especially as regards the head so that, given two skulls of the same species, it would be easy to recognise them as belonging to one particular type. This type resemblance is, however, subject to individual deviations, as for example slight differences in one or other bones of the head. Sometimes a single specimen will differ slightly in the formation on one side of the head as compared with the opposite side. These variations, however, are minor in character and do not warrant separation from the unit presentation, which marks the type as a species. The skulls of young specimens are different from older adult ones, in that the occipital and parietal regions especially appear in the immature skull as much shorter and fused together without any clear definition between the two.

The same observations apply to the dentition. Family groups show differences from one another; but the specific characters in regard to number, kind and setting of the teeth in the various situations in the mouth are well maintained. In fact the type resemblance is preserved in a more regular way than is the case with the bones. Comparatively fewer examples of deviations are met with and the features of the dentition mark the species in more precise a manner for purposes of identification than is possible with the other characters snakes present and which are made use of for separating out the species and family groups.

The variations in the skull, dentition, and vertebral column of the families and species will be described in a general way in the text to follow and detailed in the systematic list of the species at the end of this paper.

THE ENDOSKELETON OF THE SNAKE.

General characters:—The Ophidian axial skeleton is composed of two parts, skull and vertebral column.

Vertebral column:—The backbone is made up of a series of bony perforated segments (vertebrae) placed in articular apposition so as to form a canal, the continuity of which affords lodgement for and protection to the spinal cord. The vertebrae articulate with one another on the mechanical principle of a cup and ball joint and the articular facets known as the zygapophyses at the ends of the neural arches limit torsion and lateral flexion. There are no intervertebral fibro-cartilaginous discs. Instead the centra and arches are linked up by intervertebral ligaments of stout connective and elastic tissue, overlaid by muscles, which give a certain freedom between the successive vertebrae permitting of great flexibility in the column length.

The column can be divided into five sections:—(1) cervical, (2) thoracic, (3) dorsal, (4) cloacal, (5) caudal. These five divisions are well defined in certain species, but become purely arbitrary in others. These variable characters can best be studied in the table of variations and text-figures to follow. But before going on to outline the variations in tabular form, it will be necessary here to give in a general way a description of the characters of typical ophidian vertebrae. All the vertebrae are dorsally saddle-shaped. They present four surfaces:—dorsal, ventral, anterior, and posterior articular surfaces.

Dorsal surface:—This shows the neural arches and neural spines, which conjointly form the roof of the neural canal giving lodgement to the spinal cord. They vary specifically in formation, being for the greater part of the axial length, but more so in the posterior sector, fully-convexed, semi-convexed, or inclined outwards and downwards as in the two sides of a triangle. The anterior part is much narrower and shaped somewhat differently, in that the arch is a single one, having superiorly a slight convexity with its peaked ends supported by two laterally concaved walls, which flank the sides of the neural canal. This arrangement forms an articular surface for the posterior neural arches of the vertebra, which overlap it in front. The neural arches in the vertebrae of the Krait exhibit a unique divergence. In this respect, this snake is the only exception in the Deolali series, because of the winged extensions—or alae—projected laterally and upwards from the base of the neural arches on either side. Centrally in the axial length of the dorsal surface, the arches are ridged by neural spines, or spinous processes, which are thin squared plate-like extensions of bone uprising from the junction of the neural arches. These also vary specifically, being large, small, or rudimentary. The rudimentary variety shows the neural spines reduced to an indefinite ridge ending posteriorly in a small tubercle or eminence. In the cervical vertebrae the spines are finger-shaped processes rising abruptly from the anterior neural arches and terminating in a peak above the posterior arches.

Ventral surface:—This is formed by the centrum or body of the vertebra, which represents the notochord of the embryo now segmented and ossified and serving with the haemal arches joined to it above on either side as the floor of the neural canal. The centrum proper is seen ventrally lying, as if wedged in between the ossifications surrounding it, evidenced by this surface being grooved and ridged in the long axis. The centra of the vertebrae are procoelous, that is, the centrum is cylindrical with the anterior extremity showing a cupped depression or acetabulum and the posterior end a rounded head or protuberance. The acetabulum receives the articular epiphyseal head of the vertebra in front, whilst its own head articulates with the cupped depression of the vertebra behind. From below the epiphyseal head projected downwards and backwards is a process—the hypapophysis—which is present in the cervical and thoracic vertebrae of all snakes in Deolali, with one exception, namely, *Typhlops braminus*. The specific modifications arising from the presence or absence of this process in certain situations of the vertebral column are so greatly important that they will receive special consideration later, and need not be detailed here. Laterally on either side of the cupped depression are the articular processes for the ribs; they consist of a small protuberance joined by a bony ridge to a small process pointing downwards, formed partly by the centrum and partly by the continuity of the bone above it bearing the transverse processes and pre-zygapophyses. The ribs override the convexity of the bony ridge, protuberance and small process referred to above. The articulation thus formed enables the ribs to execute a wide sweeping, laterally depressed movement from before backwards, similar to the action of oars, when used in propelling a boat.

The anterior articular surface:—This shows the anterior face of the neural arch supported by two bony pillars joined below to the centrum, all of which enclose the neural canal. Lateral to the bony pillars and just below the peaked ends of the anterior neural arch are articular facets—the metapophyses, articulating with the sister facets or post-zygapophyses of the vertebra in front. The intervertebral notches for the passage of the spinal nerve lie below the metapophyses, being formed by the concavity resulting in the union of the lateral pillars of the neural arch with the pre-zygapophyses. The latter facets are borne upon the transverse processes and articulate with the opposing facets—the anapophyses of the vertebra in front. The transverse processes themselves are superiorly convex, inferiorly concave and laterally projected. At the junction of the transverse processes with the pre-zygapophyses are the interbraterial foramens. The transverse process laminae below enclose the acetabulum of the centrum and also form the small process, which takes part in the articular surface for the ribs.

The posterior articular surface:—This presents the faces of the neural spine joined to the two posterior neural arches. These again are connected by the two haemal arches to the centrum below, which here, shows the protuberance or epiphyseal head previously mentioned. All of these surround the neural canal. On the inner aspect, below the neural and above the haemal arches at their internal junction, are the post-zygapophyses already described, as being in articulation with the metapophyses of the vertebra behind. At the lower extremity of the neural arches, at their external junction wih the haemal arches and inferior to the post-zygapophyses, are the anapophyses, which as previously mentioned articulate with the pre-zygapophyses of the vertebra behind. The concavity of the haemal arches form the roof of the intervertebral notches, which as stated give exit to the spinal nerves. Below the epiphyseal head of the centrum and projected ventrally downwards and backwards is a single haemal process, the hypapophysis. This process is of definite importance and merits attention, because by the presence or absence of it in certain situations the various species become divisible into four distinct groups. It should be noted that the hypapophyses of the vertebrae in the cloacal and caudal sections are not the single processes as evidenced in the cervical, thoracic and dorsal vertebrae. Instead they show the terminal end divided into two processes pointing downwards in a somewhat semicircular fashion and by the integumentary investments laterally and ventrally below it form a canal for the passage of the caudal artery and vein.

Based upon these distinctions the first group of snakes includes species, which possess the single hypapophysis in a markedly developed form and of nearly uniform length throughout the first three sections of the vertebral column. The second group shows the process well developed in the cervical and thoracic divisions and from thence feature a gradual diminution in its size up to the cloacal region. The third group presents the process in a well-developed and gradually decreasing form in the cervical and thoracic vertebrae alone and the total absence of it in the dorsal division. In the cloacal and caudal vertebrae of all the snakes in the above three groups, the process is present in the bifurcated form previously mentioned. The fourth group are entirely devoid of the process throughout the vertebral column. This vertebral grouping is shown arranged in the table on p. 268 along with other variations noted in the vertebrae of the various species in the four family groups at Deolali.

Dr. Boulenger (1893-96)[1] remarks upon the presence of the hypapophysis and its modifications in the vertebrae of the Colubrinae of Madagascar. He divides them into two series according to the differences shown in that process. He also mentions that the Hydrophidae show the neural spines and the hypapophyses in a very well developed form throughout the vertebral column.

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[1] 'A Catalogue of Snakes in the British Museum', by Dr. G. A. Boulenger (1893-96), vol. i, pp. 170-1. *Ibid.*, vol. iii, p. 265.

TABLE III.—VERTEBRAL GROUPING BASED ON MODIFICATIONS IN THE HYPAPOPHYSIS OF THE VERTEBRAE IN DEOLALI SNAKES.

Species	Group	Hypapophyses				Neural spines	Other variations
		Large throughout and nearly uniform	Large and decreasing in size	Large in cervical and thoracic, absent in dorsal vertebrae	Absent throughout		
Typhlops braminus (Daud.) ...	IV	...	...	...	Yes	Nil	Very short caudal section. Rudimentary pelvis.
Python molurus (Linn.) ...	Not investigated				...	...	Short, thick caudal, vestigeal hind limbs Premaxilia dentigerous.
Eryx conicus (Schn.) ...	III	...	...	Yes	...	Rudimentary	Short, thick caudal section. Small and well-formed neural spines only on caudal vertebrae.
Nerodia piscator (Schn.) ...	I	Yes	...	...	...	Large	Tapering caudal.
Rhabdophis stolatus (Linn.) ...	I	Yes	...	...	...	Small	Do. do.
Polyodontophis subpunctatus (Dum. and Bibr.) ...	Not investigated				...	...	Do. do.
Macropisthodon plumbicolor (Cantor) ...	I	Yes	...	...	...	Large	Medium caudal length.
Lycodon aulicus (Linn.) ...	III	...	...	Yes	...	Small	Do. do.
Ptyas mucosus (Linn.) ...	III	...	...	Yes	...	Large	Tapering caudal.
Zamenis fasciolatus (Shaw) ...	III	...	...	Yes	...	Large	Do. do.
Coluber helena (Daud.) ...	III	...	...	Yes	...	Large	Do. do.
Oligodon arnensis (Shaw) ...	III	...	...	Yes	...	Small	Medium caudal length.
O. tæniolatus (Jerd.) ...	III	...	...	Yes	...	Small	Do. do.
Dipsadomorphus trigonatus (Schn.) ...	III	...	...	Yes	...	Small	Tapering caudal.
Dryophis mycterizans (Linn.) ...	III	...	...	Yes	...	Long and Small	Very long and whip-like caudal section. Vertebrae are long and narrow.
Bungarus cæruleus (Schn.) ...	II	...	Yes	...	...	Large	Medium caudal length. Neural arches are winged (Alæ).

Table III.—Vertebral Grouping, etc. (*Contd.*).

Species	Group	Hypapophyses				Neural spines	Other variations
		Large throughout and nearly uniform	Large and decreasing in size	Large in cervical and thoracic, absent in dorsal vertebrae	Absent throughout		
Naia naia, var *cæca* (Merr.) *Naia tripudians* (Merr.) ...	II	...	Yes	...	...	Small	Moderately Tapering caudal.
Callophis trimaculatus (Daud.) ...	II	...	Yes	...	...	Nil	Short caudal length.
Vipera russelli (Shaw) ...	I	Yes	...	...	...	Large	Do. do.
Echis carinata (Schn.) ...	I	Yes	...	...	...	Large	Do. do.
			Species extraneous to Deolali				
Dipsadomorphus beddomei (Wall)	III	...	...	Yes	...	Small	Long and whip like caudal.
Polyodontophis collaris (Blgr.).	II	...	Yes	...	...	Small	Tapering caudal.

Dr. Sunder Lal Hora (August 1933)[1] commenting on the evolution of the respiratory organs in fish says:—'In all the instances that so far have been studied, there is strong evidence that the evolution or the modification of the respiratory organs in fishes is purposive, and that it is the direct result of the habits of the organisms concerned.' The question arises, as to whether the vertebral grouping based on the modifications of the hypapophyses noted in the vertebrae of the Deolali species bears any relation to the habits of the snakes involved. It is notable that the vertebral grouping, *per se*, actually places the majority of the snakes into a natural order consistent with the habits displayed. As this point is of some interest, it will be necessary here to digress in order to discuss these relations.

Group I, with *Nerodia piscator* as type, suggests a semi-aquatic mode of existence. The vipers, however, falling into this group furnish an obstacle, in that they are generally encountered in the open fields. The finding of the vipers on land though, does not necessarily preclude a semi-aquatic phase, which may be occasionally resorted to by them, but not generally observed and known. Our knowledge of the habits of snakes is greatly deficient and the life history of any one of them has as yet not been completely ascertained. On a closer study of the snakes in the first group, the striking fact emerges that all of them without exception have the costal scales strongly keeled. Whether the keeling of the scales is purposive and a helpful feature in allowing of a semi-aquatic mode of life is difficult to say. *Nerodia piscator* is definitely known to be semi-aquatic in its habits—in fact spending more of its life in water than out of it. Excepting the vipers, the others in this group put in an appearance during the wet seasons and in the case of *Macropisthodon plumbicolor*, the writer has found aquatic frogs *Rana cyanophlictis* (Schn.) in the alimentary canals of very young specimens, 7 to 9 in. long, all of which were at Deolali recovered near to streams perennially flowing with water. That *Rhabdophis stolatus* aestivates during the dry weather and reappears with the monsoon is generally well known. Mr. Prater (April 1933)[1] in referring to this species says:—'Round Bombay these snakes disappear from the country side during the dry months but are abundant in our fields as soon as the rains break.' As regards the vipers, curiously enough all of them—8 in number—were secured in the riverain tract adjacent to Barnes' High School. On its south side in close proximity, the river Darna bounds the area. On the north side of the school is a tributary stream known as the 'Wadi'. The school stands on the highlands of the delta formed by these two rivers. The vipers were all localised to this area. Mr. Flynn (November 1932)[2] secured two Russell's vipers from a local snake charmer who assured him that he had caught them at a place a few miles from Malir Railway Station (about 18 miles from Karachi) in a vegetable garden not far from a pool of water. Again Mr. Rowland records the occurrence of the Russell's viper at Jherruck (Karachi District) on the Indus river (August 1933).[3] Dr. Corkill (February 1932)[4] emphasises the fact that the four specimens of *Echis carinata* in his survey came from the Middle Euphrates and none from elsewhere in Iraq. This area is subject to inundations. Turning to the evidence furnished by Col. Wall[5] in the distribution shown by him for these two vipers, we find the Russell's viper much more common in the basins of the great rivers, like the Irawady and Indus and other riverain lands.

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[1] 'Respiration in Fishes', by Sunder Lal Hora, D.SC., F.R.S.E., F.A.S.B., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 3, p. 551 (15th August 1933).

Echis carinata is stated to extend through Rajputana (the particular locality is not defined), the Punjab, Sind and Baluchistan. All of these are coursed through by large rivers, excepting Rajputana and Baluchistan, which are less rivered and more sandy and dry. In Baluchistan the terrain is for the most part barren, but it is undermined with subterranean water galleries locally known as 'Kraiz'. Col. Wall (1928)[1] quotes Vidal's figures for the Ratnagiri District (which has an annual average rainfall of 108 in.), where during 6 years Government rewards were paid on an average of 225,721 phoorsas (*Echis carinata*) per annum. When the reward was raised 115,921 were paid for in eight days from December 2nd to 10th, 1862. Although this snake has been declared to be a desert form, the location and immense numbers shown for it in Ratnagiri is certainly converse evidence. Relatively few have been found in the dry sandy regions and there is an absence of detailed information as to the particular localities in the wide stretch of desert lands like Rajputana. It would appear therefore that the peculiar habitat and distribution of these two vipers and possibly also other heavily keeled species of this family and the sub-family of pit vipers, are controlled and influenced by riverain tracts; that they tend more to hug the waterways and extend on either side up the tributary streams, widening their distribution as they go. The point as to whether or not there is a semi-aquatic phase necessitated in their life history requires investigation.

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[1] 'The Social Life of Snakes', by S. H. Prater, M.L.C., C.M.Z.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 2, p. 472 (April 1933).

[2] 'The Family of a Russell's Viper', by A. A. L. Flynn, V.D., C.M.Z.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 1, p. 271 (15th November 1932).

[3] 'Occurrence of the Russell's Viper in Lower Sind', by J. W. Rowland, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 3, p. 758 (15th August 1933).

[4] 'The Snakes of Iraq', by N. L. Corkill, M.B., CH.B., F.Z.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3, p. 570 (15th February 1932).

[5] 'The Poisonous Terrestrial Snakes of our British Indian Dominions etc., etc.', by Col. F. Wall, I.M.S., K.H.S., C.M.Z.S., pp. 53-4 and 59-61 (1928).

Group II, with the binocellate Cobra as the index point to purely terrestrial forms. This is shown by their habits. It is significant that all the Proteroglypha are included in this group.

Group III, with *Dryophis mycterizans*, a typical tree snake, indicates a semi-arboreal series or class with some scansorial powers. Most of the snakes in this category exhibit a capacity for climbing. The author in search of evidence on this point tried out living specimens belonging to this group and verified that five of these species are fairly efficient climbers, namely, *Dipsadomorphus trigonatus*, *Coluber helena*, *Oligodon arnensis*, *O. taeniolatus*, and *Lycodon aulicus*. The last of these gave the finest demonstration. They readily negotiate, though somewhat laboriously the perpendicular branches. The ascent is made in spiral corkscrew fashion by alternate sectional body grips. The cervical and thoracic regions first gain a hold and by muscular action the dependant parts of the body are drawn up. The caudal section then firmly secures a grasp, while the cervical slowly relaxes and follows the head in its further ascent assisted by the thoracic division, until in this entwining movement the elastic limits of these parts are reached. The caudal part then releases its hold and is drawn up with the dorsal section loosely encoiled. This latter region of the body appears to take no active part in the transaction. They can move easily and quickly over the broad leaves of the smaller branching tops of a monkey fig tree. All of these snakes are comparatively slender and light of body with tapering tails. There are two exceptions in the long and uniformly muscular species *Ptyas mucosus* and the shorter but stoutly formed *Eryx conicus*. A half-grown specimen of the former, 4 ft. 11 in. in length, was found on the sloping branch of a monkey fig tree, 15 ft. above the ground. There is no direct evidence to bear in the case of *Eryx conicus*, which is a constrictor. The power of constriction though in itself should facilitate climbing, while the fact that such snakes prey and feed on the squirrel suggests that they may be also partly arboreal. One of these snakes fell 30 ft. from the roof on to the verandah of a building and this at least is some evidence of its capacity for climbing. These two species, although anatomically correlative with and allied to group III, are nonetheless terrestrial in habits, because of other specialisations, such as the speed attainment of *Ptyas mucosus* and the constricting power and burrowing capacity of *Eryx conicus*. It is remarkable, that here again in these two species, there is featured a slight keeling of the costal scales. Thus the morphological variations occurring as they do in several directions suggest adaptations fitting them to a variegated mode of life, mainly terrestrial, partly arboreal and perhaps semi-aquatic.

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[1] 'The Poisonous Terrestrial Snakes, etc. etc.', by Col. F. Wall, I.M.S. (1928).

In contrast with the aforementioned species, a Cobra 3 ft. 9 in. long was tested in order to assess its powers for ascending heights both vertical and slanting. It appeared to be considerably inhibited and did not show any prowess or sustained inclination for ascending even the sloping branch upon which it was placed. On the contrary it slid off and fell from a height of 10 ft. in its desire to regain 'terra firma'. This inability on its part may have been caused by fright. Mention has been made of the finding of a pipistrel in the stomach of one of these snakes, which points to apparent if not real evidence of a climbing capacity. The species in this group, however, are mainly terrestrial in their habits.

In group IV, there is but one species belonging to the family Typhlopidae, namely, *T. braminus*. This worm-like snake is typically burrowing. Observations, as regards *Eryx conicus* and *Oligodon taeniolatus*, showed evidence of a like habit. When kept in captivity in boxes well filled with sand and earth, both these snakes remained during daylight at a depth of 4 in. or more in the case of the former and 2 in. in the latter. A gardener in raking up the gravel on a garden walk, brought to light a small *Oligodon taeniolatus*. The snake hurriedly burrowed into the sand again and insistently repeated the act on the several occasions when it was disinterred. In the case of the other species maintained alive in sanded boxes, namely, (1) *Dipsadomorphus trigonatus*, (2) *Oligodon arnensis*, (3) *Lycodon aulicus*, (4) *Macropisthodon plumbicolor*, (5) *Naia naia*, (6) *Coluber helena*, (7) *Nerodia piscator*, there was no evidence of burrowing habits. Rather on the other hand (2), (3) and (6) experienced no difficulty in clinging to the narrow divisions in the angles formed by the top and side panels of the box and remained in that position all day, descending to the floor only at night. Number (7) rested during the day immersed in the water receptacle, sometimes with its snout just above the water level. The others when diurnally inactive coiled themselves on the sand itself.

It should be mentioned that in Group I, *Macropisthodon plumbicolor* displayed evidence of some scansorial powers and surprisingly enough, when hanging by its tail from a metal ring at the end of a long metal rod, it was able to draw itself up by a reversed muscular action directing the body backwards. It would appear then that the vertebral variations and the differences in the scaled exoskeleton suggest evolutionary gradations adapting the snakes in various ways to the selected mode of life. The references[1] studied on the subject of variations in the vertebrates, indicate that the modifications may be in the nature of progressive and retrogressive mutations brought about possibly by environmental factors, as a sequence of natural selection in their evolution from some pre-existing marine type. The standard development attained would be represented by the characters presented in the typical species, which occupy the key positions in each group.

Variations in the Vertebrae and Ribs of the Deolali Species.

The vertebrae commencing with the cervical series are small in size. The numbers vary in the different species and range from 3 to 8. They are recognised by the neural spines presenting finger-like processes and the hypapophyses being well developed. The thoracic vertebrae, in contrast, show the neural spines as squared plate-like extensions.

The Atlas or 1st cervical vertebra, as will be noted in the text-figures, shows minor individual differences in the formation dependant upon the kind of snake. The articular principle is the same in all and is in no way involved. The Atlas is unique in character and consists of a narrow bony ring, broader superiorly, and inferiorly constricted. The dorsal surface is comparatively narrow and the neural spine is rudimentary. The ventral surface has an abbreviated hypapophysis.

The anterior articular face has two apertures separated by a cartilaginous septum. The superior or neural canal is roofed over by the neural arches for the passage of the spinal cord. The inferior aperture receives in articulation the single condyle on the occipital bone of the skull. It is bounded on either side by the haemal arches and these along with the superior surface of the hypapophysis form three articular depressions, which fit corresponding eminences and the condyle of the occipital bone.

The posterior articular face presents similar features, as outlined above and articulates with the axis. Projected laterally and posteriorly from either side of the junction of the neural with the haemal arches are processes in the nature of cervical ribs. Above these at the termination of the neural arches are roughened surfaces, which represent the post-zygapophyses.

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[1] 'The Origin of Species', by means of natural selection, by Charles Darwin, M.A. (1917 reprint of first edition published in 1859-60).

'Manual of Zoology', by H. A. Nicholson, M.D., D.SC., Ph.D. (Gott.), F.L.S., F.G.S., 7th edition, p. 43 (1887).

'General Biology', by J. F. Abbott, Professor of Zoology in Washington University, pp. 199-241 (1914).

'Zoology', by E. W. MacBride, F.R.S., pp. 73-81 (1918).

'The Evolution of Living Organisms', by E. S. Goodrich, F.R.S., pp. 27-69 (1918).

The axis or 2nd cervical vertebra is in all snakes 1 mm. larger than the 1st cervical, except in the case of *Dryophis mycterizans*, in which it is half a millimetre larger; this vertebra is also subject to slight individual differences dependant upon the length, the size, and kind. The dorsal and ventral surfaces show more accentuated neural spines, arches and hypapophyses. There are two of the latter processes on the ventral surface—the broader projected downwards from the anterior end has been designated in the text-figures as the haemal process in order to distinguish it from the posterior process or hypapophysis proper.

The anterior articular face articulating with the Atlas, shows the neural arches covering the neural canal joined to the Odontoid process, which projects forward as a prominent bony extension fitting into the lower aperture on the posterior articular face of the Atlas. Below the Odontoid is the haemal process already mentioned.

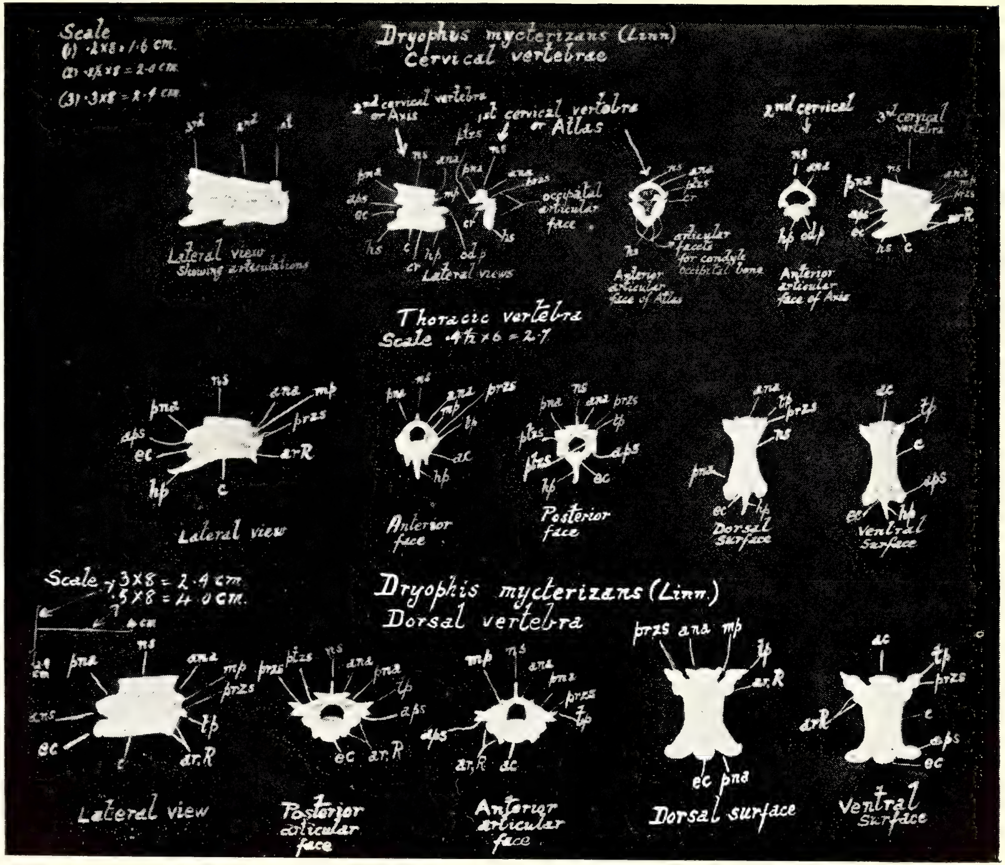
The posterior articular surface shows the neural spines somewhat extended to a peak and the neural arches joined to the centrum, which here features a protuberance or epiphyseal head. Below this is the hypapophysis. From the junction of the neural arches with the haemal arches spring the cervical ribs which are much larger than those noted in the Atlas.

The successive cervical vertebrae increase in size, each being one millimetre larger than the preceding one and in *Dryophis mycterizans* half a millimetre larger. Except for the finger-like neural spines in some snakes they show the same features as have already been described for a typical vertebra.

The thoracic vertebrae in sequence gradually increase in size—length, width and depth—and are similar in character to a typical vertebra, numbering from 33 to 36. The largest dimensions are attained about the middle of the vertebral column in the anterior dorsal series. From thence there is a corresponding diminution up to the tip of the caudal section. The dorsal vertebrae vary in number and may be from 80 to 130 or more dependant upon the length of the snake.

The cloacal and caudal vertebrae show the same features as described in a general way for a vertebra in any of the other sections of the vertebral column, but they are differentiated from them by the presence of short processes in the nature of false ribs. The vertebrae in the cloacal section also vary in number, sometimes being four in some and three in others, irrespective of the sex. So also in the caudal division, the numbers of the vertebrae vary and depend upon the species and caudal length and may be in the count from 23 to 140 vertebrae. The last three caudal segments are very minute and inseparably fused.

A striking variation noted is that relating to the total number of vertebrae in the body length. This is not a constant figure


Scale
(1) ·2x8 = 1·6 cm.
(2) ·25x8 = 2·0 cm.
(3) ·3x8 = 2·4 cm.
Dryophis mycterizans (Linn)
Cervical vertebrae
3rd
2nd
1st
Lateral view
Showing articulations
2nd cervical vertebra or Axis
1st cervical vertebra or Atlas
ns
ana
pna
prs
aps
ec
hs
c
cr
hp
odp
mp
occipital articular face
Lateral views
articular facets for condyle occipital bone
Anterior articular face of Atlas
2nd cervical
Anterior articular face of Axis
3rd cervical vertebra
arR
Thoracic vertebra
Scale ·4½ x 6 = 2·7
przs
tp
ac
ptzs
Lateral view
Anterior face
Posterior face
Dorsal Surface
Ventral Surface
Scale ·3X8 = 2·4 cm
·5X8 = 4·0 cm.
Dryophis mycterizans (Linn.)
Dorsal vertebra
ans
ar.R
Lateral view
Posterior articular face
Anterior articular face
Dorsal surface
Ventral Surface

Cervical, Thoracic and Dorsal Vertebrae of *D. mycterizans* (Linn.).

For explanation of lettering see end of article.

and differs in the count even in the same species. A similar meristic variation is encountered in the numbers of the ventral plates on the belly. The ventral shields and the vertebrae are numerically closely correlated. The ventral shields correspond exactly with the number of vertebrae provided with free and true ribs. A pair of these articulate with each vertebra in the cervical, thoracic, and dorsal divisions, excepting the first and second cervical, which are devoid of them, but as previously stated show short rudimentary projections in the nature of cervical ribs fused with the body of the vertebra. The true ribs terminate at the junction of the last dorsal vertebra with the first cloacal. The cloacal and caudal vertebrae on the other hand, although, having no free articulating ribs attached, show in the cloacal series a pair of short rigid processes inseparably fused on either side with the vertebral bodies and in the caudal section one shorter rigid process on either side similarly ankylosed to the bodies of the vertebrae. These short rib-like extensions diminish in length proportionately with the decrease in size of the vertebrae from the region of the vent backwards and disappear in the last three fused caudal segments in which they are reduced and represented by tubercles. All of these pseudo ribs are shaped like the true ribs with the convexity on the dorsal aspect, except in the case of the second and lower placed processes of the cloacal group, which are convex on the ventral surface and curve outwards and upwards toward the superiorly positioned process. They in continuity with the true articular ribs round and mould the body in these regions. There is no sternum in snakes. The distal ends of the ribs are free. The terminal points are cartilaginous, somewhat bulbous in some and pointed in others, and attached by muscular, connective and elastic tissue to the abdominal scutae. They thicken in the length from without inwards toward the proximal or vertebral termination. The dorsal convexity of the rib is ridged and the ventral concavity is rounded. It is slightly flattened in the dorso-ventral diameter and broadens out at the vertebral end, where it consists of a transversely placed rod of bone, which presents three articular portions: (1) capitulum or head of the rib, (2) tubercle of the rib, with a slight depression anterior to it, and (3) small process for the attachment of ligaments. The whole of this articular surface is adapted to fit corresponding formations previously described as in the vertebra and completing the suspensorium or articular arrangements for the ribs. The lengths of the ribs vary in snakes. They are of uniform length throughout in some species, others show the shorter lengths attached to the cervical and thoracic, gradually increasing and being longest in the midbody, and then decreasing proportionately toward the vent. Again as in the Cobra, the longest ribs are those in the cervical and part of the thoracic regions corresponding to the position of the hood, which in fact is caused and produced by muscular action extending the ribs and expanding the neck parts of the exoskeleton. The co-operation of the muscles, ribs and the ventral plates secures mobility and locomotion.

THE ANATOMICAL RELATIONS OF THE VERTEBRAL COLUMN WITH THE UNDERLYING ORGANS AND VISCERA.

The underlying organs and viscera help in an arbitrary way in distinguishing the various sections of the vertebral column, because by their approximate relative positions the vertebral divisions become designated. In this respect, these relations are of some value in those species falling into the vertebral groups I, II and IV, in which the peculiarities of the vertebral hypapophyses, as previously outlined present difficulties in separately defining them. In mentioning these relations, advantage will be taken of the opportunity here offered to briefly describe the viscera and organs.

The relations in the case of the cervical and thoracic vertebrae, which for convenience will be considered together, are the alimentary canal, trachea, tongue and heart in the majority of snakes, but in some the anterior parts of the lungs and liver also become involved. The first two vertebral divisions roughly extend over one-third of the body length. The dorsal section, dependant upon the species and in particular the caudal length, is generally the greatest in extent. Under these varying conditions the situation of the organs and viscera differs in the various snakes.

The stomach consists of a long, distensible, funicular membrane in correspondence with the elongated form of the snake. There is no distinction as between the oesophageal tube and gastric envelope, or stomach proper, as seen in the higher vertebrates. It lies above the trachea and tongue and anteriorly communicates with the mouth. Posteriorly it unites with the intestines by a pyloric thickening.

The trachea is long and tubular and composed of cartilaginous loops, which are ventrally un-united and held together by a fibro-elastic investment. Around this again is a membranous covering. Anteriorly the laryngeal opening lies in the mouth above the tongue. The hissing snakes use this during the respiratory act by constricting the aperture in order to produce the characteristic sound. Posteriorly it terminates in a blunted open end directly into the canal of the right lung. There are no bronchial tubes and no ramifications of them into the lung substance. The posterior section of the trachea, close to the terminal lung end, is in relation with the heart.

The tongue lies below the trachea and is attached to it for approximately half its length. It is bifid and contractile and consists of two cylindrical lobes of muscular tissue sheathed in a connective tissue investment to which on either side and bound by similar integument in close apposition are attached the two filamentous hyoid bones. These are of bristle-like thickness in the smaller snakes. They exhibit both rigidity and resilience, and measure from 2 to 4 in. in length, dependant upon the kind and length of the snake. The terminal points of these bones are embedded in the mouth by a fibro-cartilaginous union, direct with the subcutaneous tissue of the epiderm forming the floor of the lower jaw between the two mandibles. The position of this attachment varies in the different species. It is placed somewhat forward in the mouth in those that hiss like the cobra, krait, and most vipers, and lower down in others at a point corresponding with the base of the skull. The tracheal aperture coincides with these fixation points and is situated superiorly above them and closely and firmly bound with the investment sheathing the tongue and the hyoid bones. The posterior attachment of the tongue and also that of the hyoid bones to the trachea for two-thirds of their lengths is of a loose and free nature, being but thinly covered by fascia lata. The hyoid bones at this extremity meet behind and enclose the tongue, which is attenuated and firmly welded to them by the investments. The muscular action of the tongue causes the protrusions and at the same time draws up and arches the hyoid bones, which limit the extent of its protractility. Retraction of the tongue is effected by muscular relaxation and by the return of the hyoid bones to their former rigidity, by which action the tongue is pulled back into its position in the mouth. Apart from the action of the hyoid bones, the tongue itself has in part an elastic recoil. This mechanism enables the snake to use the tongue in the peculiar manner so often seen.

The heart lies a little above the junction of the trachea with the lungs and is partly supported by them and enveloped in the pericardial serous membrane. It is three-chambered, consisting of right and left auricles, completely divided by a septum, and behind these the connecting ventricle. This is partly sectioned, but actually consists of only one chamber. Communicating with the heart cavities are the main blood vessels. These are the right and left aortic arches, the pulmonary artery and vein, and the vena cava inferior. Anterior to the heart and supported partly by its investments lies the thyroid gland. The position of the heart varies in the species. In some it is situated below the tracheal union with the lungs and it is then partly supported by the lungs.

The lungs are unsymmetrical lobes. The right lung is elongated and tubular. The left lung is rudimentary in character and in the majority of snakes is missing. The right lung is well developed and ends posteriorly in a membranous recess or air chamber. This is a marked feature in *Nerodia piscator*, in which it is a sausage-shaped capacious cavity. The lungs are largely reticulated capillaries, between which are air spaces. They are positioned dorsally above and related with the heart, stomach, and the anterior parts of the liver. Normal respiration in the snake is timed at 3 per 65 seconds.

The liver consists of two long, cylindrical lobes, the larger and longer lobe lying to the right side and connected by a long hepatic duct to the gall bladder which in most snakes is detached at some varying length behind and away from the right lobe, at a point corresponding roughly to the middle of the body. The anterior end of the liver is connected to the heart by blood vessels. The posterior terminal point of the right lobe ends a little below the junction of the stomach with the small intestines, both of which lie laterally on the left. The thoracic vertebrae here terminate at a point midway in the liver length.

The dorsal vertebral division is in relation with the posterior half of the liver, the gall bladder and its duct, the lower end of the air reservoir, the terminal end of the stomach, the small and large intestines, the urino-genital appendages and organs.

The small intestine lies to the left side of the body and is transversely folded and covered by its mesenteric investments. Here also in the larger species is a protective padding of fat lobules lining the ventral aspect. The small and large intestines are connected by an ileo-caecal union where also lies the pancreas. Lateral to the large intestines on either side are placed the female ovaries and oviducts and the male vasa deferentia, which are long and open by separate apertures into the cloaca. The left ovary and oviduct appear rudimentary. Dorsally above the genitals lie the urinary appendages terminating in the papillae urinary situated in the common cloacal aperture. There is no urinary bladder in the snake. The terminations of the large intestine and the urino-genital appendages are in relation with the cloacal vertebrae.

The caudal vertebral section:—Here there are only muscles and no organs. On the ventral surface posterior to and immediately behind the vent on either side are two small pores connected by very short ducts to two glands, which secrete a liquid substance. This fluid varies both in colour and consistency in the different species, being creamy white, serous yellow, or dark and viscid. The physiological significance and function of these glands are obscure. It is believed to be hedonic. These glands are termed scent glands by Mr. Prater (1933),[1] who from the existing evidence as to the association of the sexes and the widespread belief that the mate can trail out its dead companion to wherever the latter may have been taken, advances the theory subject to certain reservations, that by the scent given off from the glandular secretions, the sexes may be able to trace and find each other. This is believed to be the function of the two pairs of glands, one pair located in the throat and the second in the region of the vent, in crocodiles. Lizards too have femoral pores exuding a fluid said to serve some such purpose. In the case of the snakes however, as Mr. Prater observes, 'It is true in many species of snakes these glands have been found to be active in all stages of growth even in hatchlings which are not sexually mature, and as such it is argued that the glands are not directly connected with the sexual functions of the snake.' The same features also appear in the crocodile and instances are quoted of baby crocodiles and alligators everting the glands inside out like the fingers of a glove when held by force. The glands are stated to be active during the breeding season and can be stirred to function under stress of fear and excitement. It is regretted that no proper record was maintained on this aspect in the survey at Deolali. The impressions gained however were that from young, half-grown, and some adult specimens no gland juice could be expressed. The adults and especially the gravid females certainly produced a heavy secretion with a faint peculiar smell which became oppressive when decomposed. In the instance of an adult male killed by sun rays, it was found that the genital organs had prolapsed, as they were protruding from the vent a little before death actually occurred. The glands were also exuding their juice. Cover slip and film preparations both from the organ and gland were separately made and microscopically examined. That from the genital organ showed dead spermatozoa and cellular matter while the gland fluid was composed of cellular debris alone. This male was a *Macropisthodon plumbicolor.* The secretion from the glands of the gravid females showed in addition to the cellular content numerous fat globules. The other males in this survey showed dead spermatozoa in the expressed seminal secretions. It is presumed that the zoosperms were dead because of the absence of motility, which one would expect in post-mortem specimens investigated some time after death. But in the first case quoted, the expectation was to find motile sperms, because the secretion was taken and examined at a time when the snake was in a coma and still breathing fitfully. The heart was also faintly audible on auscultation. Under the circumstances the death of the spermatozoa which were all possessed of very long flagellae can only be attributed to the hyperpyrexia. It is hoped at some future time to further explore the point connected with the viability of the zoosperms.

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[1] 'The Social Life of Snakes', by S. H. Prater, M.L.C., C.M.Z.S., J.P., *Journ., Bombay Nat. Hist. Soc.,* vol. xxxvi, No. 2, p. 469 (15th April 1933).

It may be that the function of the gland juice is intended as Mr. Prater suggests to guide the sexes together during the, as yet unknown, periods of the breeding seasons. In the association of the sexes, also, the glands are possibly stimulated under the influence of the autonomic nervous ganglia, or the homologue of the 'nervi erigentes', which must exist most probably in the cloacal region, whereby the glands of the sexes secrete fluids, the admixture of which at insemination form a medium suitable and necessary for the viability of the spermatozoa until they are able to reach the oviduct.

THE SKULL.

In the snake the skeleton of the head is well ossified and made up of the cranium proper or brain case, which occupies the posterior part of the skull behind the orbital apertures, and the several bones forming the anterior half of the skull inclusive of the olfactory capsules.

The cranial bones are the basi-occipital, ex-occipital, and the supra-occipital. The basi-occipital serves as the floor of the posterior section of the cranial cavity and ventrally limits the foramen magnum, where are featured the single condyle and the two small eminences articulating with the Atlas.

The ex-occipital superiorly forms the roof of the posterior section of the brain chamber and is in some species ridged by a crest of bone, the supra-occipital, at the junction with the parietals.

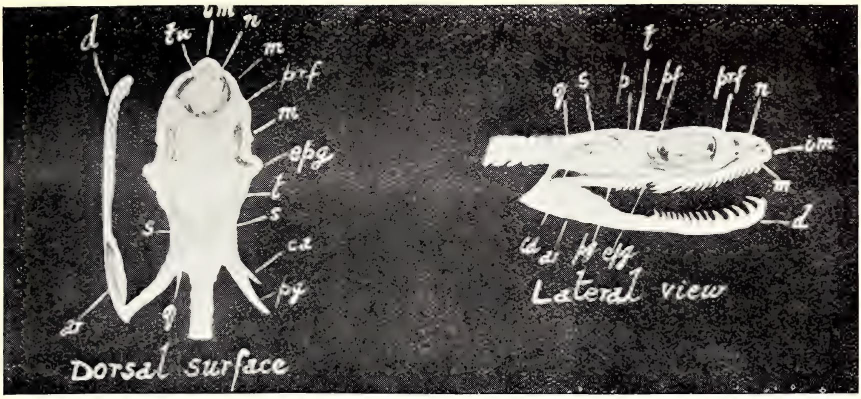
The parietal bones form practically the entire roof of the encephalon. In the young immature skulls, centrally dividing the bones can be seen the sagittal suture, which becomes obliterated or nearly so in the older skulls. The bones end posteriorly in a terminal point at the union with the supra-occipital.

The sphenoidal bones are the basi-sphenoid, the ali-sphenoids, the pre-sphenoids and the orbito-sphenoids. The basi-sphenoid is a median plate of bone inferiorly supporting the brain. In the vipers there is a process projected downwards from it and posteriorly curved and resembling in shape and formation the hypapophyses of the vertebrae. It serves for the attachment of the longus colli muscle. The ali-sphenoids are wing-like bones fused with the basi-sphenoids. They help in forming the floor of the cranial cavity and are loosely related with the ecto-pterygoids and palatine bones. The sphenoid is a forward extension of the basi-sphenoid.

The pre-sphenoids are laterally compressed with the basi-sphenoids and in them the optic foramen is an aperture through which the optic nerve connects the eye with the brain. Attached to the pre-sphenoids are the lamellar orbito-sphenoids surrounding partially the optic foramen and forming a wall separating the cranium from the orbital aperture. These bones are continued forward as the vertical inner walls of the orbit.

The squamosal bones are two separate, flat and long bones which vary in shape and length in the species possessed of it. They are placed above the periotic region in articulation with the mastoid surface and in relation with the occipital and parietal bones. At the posterior portion of the free ends of the squamosals, the quadrate or tympanic bones articulate.

The periotic comprise the auditory, mastoid and temporal regions of the cranium. They consist of the pro-otic, epiotic and opisthotic. In the adult skull they are fused to form an irregular mass. Laterally below the squamosal bones the face of the periotic is ridged and perforated by apertures. These are the fenestra rotunda, fenestra ovalis and the foramen for the 5th nerve. The fenestra ovalis takes part in the auditory apparatus by the attachment of the Columella Auris to a stapes or stirrup-like plate on its posterior lip. The Columella Auris is a thin round rod of bone, which represents the ossicles of hearing and at its spatulate ends, by fibrous unions, connects up the periotic with the quadrate or tympanic. The hearing apparatus of the snake appears structurally rudimentary and defective. The ossicles are merely vestigeal in character and there is no membranum tympanum proper and no external auditory meatus. Furthermore there are the peculiar anatomical dispositions of the muscles; namely: the digastric; the temporalis anterior, middle,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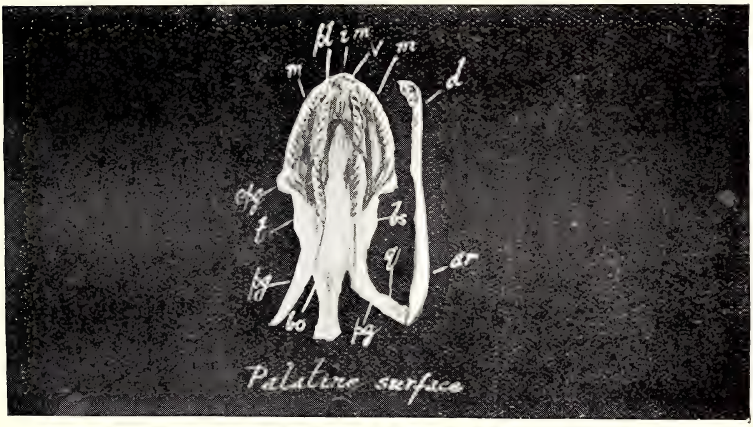
Lateral view

Skull of *Dipsadomorphus beddomei* (dorsal and lateral view).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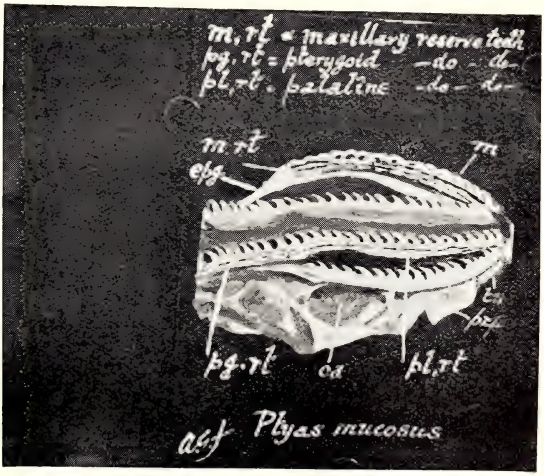
Palatine surface

Skull of *D. beddomei* (ventral view).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Ptyas mucosus

Skull of *Ptyas mucosus* (ventro-lateral view).

For explanation of lettering see end of article.

and posterior; the cervico-squamosal; the cervico-angularis, and the sub-occipito-angularis, which are well developed especially in the vipers; as well as large poison glands, overlaid upon the periotic surface and around the Columella Auris. The latter must be considerably inhibited in the reception of sound waves and under the circumstances audition in the snake cannot be very helpful. This is borne out by the very behaviour of snakes. The vipers certainly act as if they were deaf; and the majority of them exhibit more a dependancy upon the acuity of vision and probably the sense of smell to guide them rather than hearing.

The bones entering into the formation of the anterior half of the skull are the frontals, post- and prae-frontals, nasals, intermaxillary or praemaxilla, ethmo-turbinals and the vomers. The separate bones in articular relation with some of the foregoing are the maxillaries, palatines, ecto-pterygoids and pterygoids. These are bound by cartilaginous septa, muscles and ligaments and kept in position.

The frontals in young specimens are divided mid-dorsally by sutures, which are absent or represented by denser lines of ossifications in the older skulls. They are thin plates of bones placed centrally between the orbital apertures, where superiorly above the pre-sphenoids they also partly roof it. From the anterior portion a slender plate of bone is projected vertically downwards partitioning the olfactory passages in the ethmoidal region.

The post-frontals lie in the posterior corner of the orbit and furnish the zygomatic process, which circularly bounds the posterior part of it.

The prae-frontals form the anterior orbital arch and superiorly are suturally united with the frontals and separated from the nasals by a depression which is bridged over by cartilaginous connections.

The nasals are thin bony plates suturally divided in the axial length and lying in front of the frontals, to which they are posteriorly united by peaked terminals. Medially they broaden out and anteriorly end in a point. They vary in shape in different species. They cover the maxillo-turbinals and naso-turbinals and anteriorly help to form the nasal apertures of the exoskeleton.

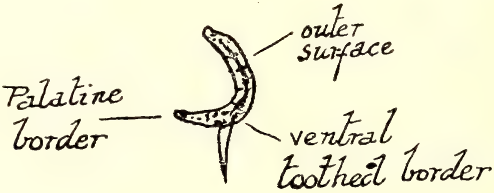
The intermaxillary or praemaxilla is suturally united with the nasals and is projected forward and downwards, convexed dorsally and anteriorly and terminating in two lateral processes, which are folded inwards to align with the ends of the maxillary bones nearly touching them. In *Python molurus* this bone is dentigerous.

The turbinal bones lie beneath the nasals and mainly form the olfactory capsules consisting of the maxillo-turbinals and the naso-turbinals which bound the nasal cavities.

The vomers are rounded bony plates fused with the turbinal bones on their ventral aspects. They occupy the anterior section in the roof of the mouth just behind the intermaxillary.

The maxillary bones are the most important in the skull of the snake. The variations in their size, length, and formation, and particularly the dental features, as has been stated, help in the differentiations between the families Colubridae and Viperidae. To these bones are ankylosed the poison fangs, which play so significant a part in distinguishing the Thanatophidia. The variations in the maxillary bones and the dentition will be better appreciated by a reference to the text-figures of the species dealt with. It was emphasised earlier in this paper that in the Colubridae the maxillary is long, thin and horizontally positioned, whereas in the Vipers it is thick, short and obliquely set.

The maxillaries are placed laterally on either side of the upper jaw. They are in relation anteriorly with the praemaxilla and on their inner aspects with the palatines and pterygoids, to both of which they are joined by cartilaginous connections. Posteriorly they directly articulate with the ecto-pterygoids or transpalatine bones. It is by means of these latter bones that the maxillaries can be depressed and protracted forward by muscular action, and thus erect the fangs to assist in the act of biting and also in holding and swallowing a bolus of food. The formation is angular throughout its length, in the aglypha and opisthoglypha. A dorso-ventral section would appear as in the following diagram.



Superiorly the bones articulate with the inferior border of the prae-frontals and in the ventral surface of the bone are embedded the grooved fangs of the poisonous species and the non-perforated teeth of the aglyphous types.

The ecto-pterygoids function chiefly in the act of biting and swallowing. They are long, medium or short in length according to the kind of snake. In most of them the anterior part is flat and broadly spatulate. Dorsally it is slightly convex and angular and placed in articulation over the posterior end of the maxilla. Posteriorly it thins out and terminates in a point, where it is in direct articulation with the pterygoid. This arrangement conforms to the principle in Dynamics, whereby muscular action as the 'Power' equivalent exerted along its dorsal surface depresses the anterior end lying on the maxilla, which represents the 'Weight' to be lifted, while the 'Fulcrum' is the articular point resting upon the pterygoid. In the Vipers the anterior portion of the bone is broadened out into a winged expansion articulating at almost a right angle with the obliquely set maxilla.

The palatines are two vertically fixed plates placed in the roof of the mouth on either side of the vomers and between the maxillaries. The palatines themselves are divided by the central cavity forming the nasal and orbital apertures opening into the mouth and roofed over by the sphenoid. They are in relation with the maxillary bones in front and posteriorly are joined with the pterygoids near to or a little below the nasal apertures in the mouth. On the ventral aspect are ankylosed some solid teeth, varying in number, from 3 to 9, in the different snakes.

The pterygoids are two vertically set bony plates, anteriorly narrow and running almost parallel with each other on either side below the sphenoid to which they are ventrally related. They broaden out from near the articulation of the ecto-pterygoid and extend backwards past the base of the skull curving laterally outwards, backwards, and downwards, terminating in a point, which in many species touches the articular end of the mandible. The posterior parts of the bone are grooved either ventrally or laterally. To the ventral and inner ledge are attached numerous non-perforated teeth.

The ethmoidal region lies below the frontals in front of the cranial cavity. Posteriorly the cribriform plate partitions the brain chamber and through its perforations pass the olfactory nerves to the brain. Fused with the cribriform plate are laminae which form the nasal cavity.

The lower jaws are the mandibles on either side. They consist of two parts generally, but in the Typhlopidae and some of the other related families, of three parts, namely, a dentary portion, a ramus or articular part, and a coronoid. These several parts are suturally united. A symphysis attachment unites them in front and allows of a certain elasticity by which snakes are able when swallowing to operate either side independently. As in most bones of the snake, here too, there are variations in the formation. The most divergent type is that seen in *Polyodontophis collaris*, in which the dentary is sharply angulated inwards. The dentition in this snake in all its toothed jaw bones, upper and lower, is characteristically specific, in that the teeth are peg-topped and quite unlike any of the other species in Deolali, in which the teeth show fine points. In *Typhlops braminus*, the dentary is unprovided with teeth, while in other species there is set on its superior aspect a varying number of non-perforated teeth.

The moveable quadrate bones articulating superiorly with the squamosals of the skull and inferiorly with the lower jaw bones, complete the mandibular arch which is thus formed posteriorly. Above, the quadrate is generally broadly spatulate, and laid on the posterior section of the squamosal. It ends below in a protuberance fitting into a notch on the articular end, or the ramus of the mandible. This arrangement allows of a great lateral distension of the jaws and permits of a forward and backward extension of the mandibles to a remarkable degree.

TABLE IV.—COMPARATIVE MEASUREMENTS OF THE SKULL AND VERTEBRAL COLUMNS OF THE SPECIES IN CENTIMETRES.

		ENDOSKELETON						Exo-Skeleton	Sex
		SKULL				Column			
	No. of Specimens.	From tip of intermaxillary to occipital base	From tip of intermaxillary to inner aspcet of anterior orbital arch	Diameter of orbit in the long axis	From orbital aspect of postfrontal zygoma to occipital base	From Atlas to tip of tail	Total length of skull and column	Length of Exoskeleton complete	
Typhlops braminus (Daud.)	1	0·4	0·1	0·½	0·2½	16·4	16·8	18·7	Not ascertained
	2	0·3	0·1	0·½	0·1½	14·0	14·3	15·5	do.
	3	0·2	0·1	0·½	0·½	6·3	6·5	7·5	do.
Eryx conicus (Schn.)	1	1·3	0·4	0·3	0·6	21·2	22·5	30·0	Female
	2	1·3	0·4	0·3	0·6	...	...	...	do.
	3	1·3	0·4	0·3	0·6	...	...	...	do.
	4	1·8	0·6	0·3	0·9	34·0	35·8	43·7	do.
	5	2·5	0·9	0·4	1·2	69·0	71·5	80·5	do.
Nerodia piscator (Schn.)	1	1·1	0·3	0·3	0·5	24·5	25·6	28·7½	do.
	2	1·3	0·3	0·3	0·7	36·2	37·5	40·0	do
	3	1·9	0·5	0·4	1·0	59·5	61·4	67·5	do.
	4	2·0	0·5	0·4	1·1	86·2	88·2	97·5	do.
	5	2·4	0·7	0·6	1·1	89·0	91·4	93·7	do.
	6	2·9	1·1	0·6	1·2	...	...	...	do.
Rhabdophis stolatus (Linn.)	1	1·3	0·4	0·3	0·6	44·5	45·8	53·7	do.
Macropisthodon plumbicolor (Cantor.)	1	0·9	0·2	0·3	0·4	11·1	12·0	13·0	do.
	2	1·0	0·2	0·3	0·5	21·2	22·2	23·5	do.
	3	1·1	0·3	0·3	0·5	25·4	26·5	31·2	do.
	4	1·6	0·4	0·4	0·8	45·0	46·6	53·7	Male
	5	1·8	0·5	0·5	0·8	48·4	50·2	58·7	Female
	6	1·8	0·5	0·5	0·8	56·5	58·3	...	do.
	7	1·8	0·5	0·5	0·8	56·8	58·6	60·5	do.
	8	1·9	0·5	0·5	0·9	62·1	64·0	69·0	do.
	9	2·0	0·5	0·5	1·0	64·5	66·5	69·0	do.
	10	2·2	0·6	0·5	1·1	66·1	68·3	71·5	do.
Lycodon aulicus (Linn.)	1	0·8	0·2	0·1	0·5	14·2	15·0	20·0	do.
	2	0·9	0·2	0·1	0·6	19·6	20·5	26·0	do.
	3	1·0	0·2	0·2	0·6	27·3	28·3	34·0	do.
	4	1·5	0·4	0·3	0·8	50·0	51·5	55·0	do.
	5	1·5	0·4	0·3	0·8	47·3	48·8	57·5	do.
	6	1·6	0·5	0·3	0·8	51·2	52·8	63·0	do.
	7	1·6	0·5	0·3	0·8	49·5	51·1	65·0	do.
	8	1·8	0·5	0·4	0·9	60·0	61·8	73·5	do.

TABLE IV.—COMPARATIVE MEASUREMENTS OF THE SKULL, ETC. (*Contd.*).

		ENDOSKELETON SKULL				Column		Exo-Skeleton	
	No. of Specimens.	From tip of intermaxillary to occipital base	From tip of intermaxillary to inner aspect of anterior orbital arch	Diameter of orbit in the long axis	From orbital aspect of postfrontal zygoma to occipital base	From Atlas to tip of tail	Total length of skull and column	Length of Exoskeleton complete	Sex
Ptyas mucosus (Linn.)	1	3·4	1·1	0·9	1·4	212·0	215·4	225·0	Female
	2	3·2	1·0	0·8	1·4	175·5	178·7	185·0	do.
Zamenis fasciolatus (Shaw)	1	1·9	0·6	0·5	0·8	76·7	78·6	90·0	Male
	2	2·2	0·6	0·6	1·0	104·8	107·0	117·5	Female
Coluber helena (Daud.)	1	2·0	0·7	0·4	0·9	74·5	76·5	80·0	do.
	2	2·5	0·9	0·4	1·2	91·1	93·6	105·0	do.
Oligodon arnensis (Shaw)	1	1·1	0·3	0·2	0·6	29·5	30·6	35·0	do.
	2	1·0	0·2	0·2	0·6	29·0	30·0	33·5	do.
Oligodon tæniolatus (Jerd.)	1	0·7	0·2	0·1	0·4	18·0	18·7	20·0	do.
	2	0·8	0·2	0·2	0·4	25·9	26·7	27·5	do.
	3	0·9	0·3	0·2	0·4	39·5	40·4	42·0	do.
Dipsadomorphus trigonatus (Schn.)	1	0·9	0·2	0·2	0·5	12·5	13·4	2	Not ascer-tained
	2	1·1	0·2	0·3	0·6	47·0	48·1	50·0	Female
	3	1·4	0·3	0·4	0·7	57·0	58·4	62·5	Male.
	4	1·4	0·3	0·4	0·7	61·6	63·0	67·5	Female
	5	1·4	0·3	0·4	0·7	58·6	60·0	64·5	do.
	6	1·5	0·4	0·4	0·7	76·0	77·5	82·5	do.
	7	1·5	0·4	0·4	0·7	...	...	...	do.
Dryophis mycterizans (Linn.)	1	2·2	0·9	0·4	0·9	107·8	110·0	115·0	do.
Bungarus cæruleus (Schn.)	1	1·1	0·3	0·2	0·6	46·4	47·5	50·0	do.
	2	2·1	0·6	0·4	1·1	82·7	84·8	88·0	do.
	3	2·5	0·6	0·6	1·3	109·0	111·5	115·3	do.
Naia naia, var. *cæca* (Merr.) Cobra (binocellate).	1	2·0	0·6	0·5	0·9	...	...	...	do.
	2	2·1	0·6	0·5	1·0	81·5	83·6	88·7	do.
	3	2·2	0·6	0·5	1·1	76·1	78·3	85·0	do,
	4	2·3	0·6	0·5	1·2	...	...	...	do.
	5	2·4	0·6	0·6	1·2	78·7	81·1	85·0	do.

TABLE IV.—COMPARATIVE MEASUREMENTS OF THE SKULL ETC.—(*Continued*).

Species	No. of Specimens	ENDOSKELETON				Column		Exo-skeleton	Sex
		SKULL							
		From tip of intermaxillary to occipital base	From tip of intermaxillary to inner aspect of anterior orbital arch	Diameter of orbit in the long axis	From orbital aspect of postfrontal zygoma to occipital base	From Atlas to tip of tail	Total length of skull and column	Length of Exoskeleton complete	
Callophis trimaculatus (Daud)	1 2	0·5 0·5⅓	0·1 0·1	0·1½ 0·1½	0·3½ 0·3	21·0 26·0	21·5 26·5½	23·0 8·5	Female do.
Vipera russelli (Shaw)	1	3·0	1·0	0·7	1·3	121·0	124·0	135·0	do.
Echis carinata (Schn.)	1 2 3	1·0 1·2 1·4	0·2 0·3 0·3	0·4 0·4 0·4	0·4 0·5 0·7	23·0 29·0 43·1	24·0 30·2 44·5	25·0 32·5 47·5	do. do. do.
Dipsadomorphus beddomei (Wall)	1	1·5	0·4	0·4	0·7	83·0	84·5	90·0	do.
Polyodontophis collaris (Blgr.)	1	1·5	0·4	0·3	0·8	73·5	75·0	85·0	do.

POISON GLANDS.

These glands are of various kinds and constitute the homologues of the salivary glands in the higher vertebrates. In the snake, however, they are more complex in structure and specialised for a twofold purpose, defence and digestion.

In the *Thanatophidia* the glands are large and aciniform, particularly in the larger species such as the Cobra, the Krait and some of the vipers, and proportionately graded in snakes of smaller size like *Callophis trimaculatus*. They are placed behind the eye, between it and a point near to the squamosal bones and are lobulated membranous sacs both secreting and storing venom in fair quantities up to 1 c.c. The glands in the vipers are denser in structure and the venom required for immediate use is collected in a mucous capsule anterior to the fang. There is also a glandular chain along and under the supralabials (upper lip) and in some species along the outer side of the dentary below the teeth.

The Opisthoglyphous Colubridae are possessed of a salivary gland. In the Deolali species the salivary or parotid gland was found lying along the upper lip, below and away from the eye and reaching up to the angle formed by the upper and lower lip. The glands were flat, tough, dull yellow structures, shotty to the feel. There was found an additional bilobed gland situated immediately behind the eye and against it in the temporal region near to the zygomatic process of the post-frontal bone. The uppermost lobe appeared to be in the nature of a sac and contained a glairy fluid.

Some of the aglyphous Colubridae are provided with both parotid and temporal glands. But in these the parotid glands show as large, soft, lobulated masses, white in colour in contrast with the presentation seen in the opisthoglypha.

Again other aglyphous snakes showed the presence of parotid glands alone, similar in formation to those mentioned above for the same class.

The species in the survey at Deolali are grouped as under.

A. Specialised aciniform glands served by reservoir:—

COLUBRIDAE: 'PROTEROGLYPHA'.
Naia naia, var. *caeca* (Merr.) Binocellate Cobra.
Bungarus caeruleus (Schn.) Krait.
Callophis trimaculatus (Daud.) Slender Coral Snake.

VIPERIDAE: VIPERINAE.
Vipera russelli (Shaw) Russell's Viper.
Echis carinata (Schn.) The Saw-scaled Viper 'Phoorsa'.

B. Hard, yellow, parotid gland and bilobed temporal gland:—

COLUBRIDAE: 'OPISTHOGLYPHA'.
Dipsadomorphus trigonatus (Schn.) Common Cat Snake.
Dryophis mycterizans (Linn.) The Green Whip Snake.
Dipsadomorphus beddomei (imported into Deolali).

C. Soft, white, parotid gland and a single temporal gland:—

COLUBRIDAE: 'AGLYPHA'.
Lycodon aulicus (Linn.) The Wolf Snake.

D. Soft, large, white, parotid gland only:—

COLUBRIDAE: 'AGLYPHA'.
Nerodia piscator (Schn.) The Checquered Water Snake.
Rhabdophis stolatus (Linn.) The Buff-striped Keelback.
Polyodontophis collaris (extraneous to Deolali).
Macropisthodon plumbicolor (Cantor) The Green Keelback.
Ptyas mucosus (Linn.) The Rat Snake 'Dhaman'.
Zamenis fasciolatus (Shaw) The Fasciolated Rat Snake.
Oligodon arnensis (Shaw) The Banded Kukri Snake.
Oligodon taeniolatus (Jerd.) The Variegated Kukri Snake.

E. Small single temporal gland only:—

COLUBRIDAE: 'AGLYPHA'.
Coluber helena (Daud.) The Trinket Snake.

BOIDAE: 'BOINAE'.
Eryx conicus (Schn.) The Earth Boa (red).

TYPHLOPIDAE.
Typhlops braminus (Daud.) The Worm Snake.

MECHANISM OF THE BITE.

Dr. Fairley[1] at a meeting of the Royal Society of Medicine (June 1934) dealt with methods of taking dental impressions of the bite and the significance of the 'maxillary index' and the 'quadrate index' which he had introduced for determining the biting efficiency of the Australian colubrids. In snake-bite four distinct phases were recognized: (1) the strike; (2) opening the mouth and elevation of the fangs; (3) closing the mouth and the injection of venom; (4) retraction of the fangs. In the Australian colubrids there was a wide range of variation in the mobility of the fangs, the degree of elevation from extreme retraction to maximal protraction varying from 10-15 to 45-50 in the different species studied. Each pterygo-palatine-transverse arch acted as a single entity, and when the protractor muscles of the palate drew the endo-pterygoid forward, they invariably brought with it the palatine bone and the ecto-pterygoid which impinged on the posterior arm of the maxilla, driving the maxilla forwards and upwards on the articulating surface of the prefrontal. This produced a variable degree of elevation and forward rotation of the fangs which were ankylosed to the inferior surface of the maxilla; its extent could be judged by the angle formed at the ecto-pterygoid maxillary junction which, in the resting position, formed a straight line. Should this movement be doubted it could readily be demonstrated by pithing the snake, dissecting up the mucous membrane on the roof of the mouth and electrically stimulating the protractor and retractor muscles acting on the palatine arch; alternatively skulls could be prepared with the palatine arch in different positions. In these snakes the smaller the maxilla (i.e., the greater the maxillary index) the greater the forward movement of the pterygo-palatine-transverse arch and the greater the degree of forward projection of the fangs. This mechanism differed from that of the vipers, in which the movement of the maxilla on the prefrontal was a true rotary one and not a forward and upward sliding movement as described above.[2]

In the mechanism of the bite, emphasis is thus laid upon the significant factors of the maxillary and quadrate indices. As the maxillary index is governed by the size of the maxillary bone, the biting efficiency of any snake other than the viper, becomes dependant upon the possession of a small maxilla. The application to the Deolali series of the principle enunciated results in the following serial order into which the species fall in accordance with the length of their maxillary bones. The figures have been ascertained by actual measurement of the skulls and maxillary bones. The lengths of the quadrate bone have also been included to show the comparative proportions between it and the maxillary bone.

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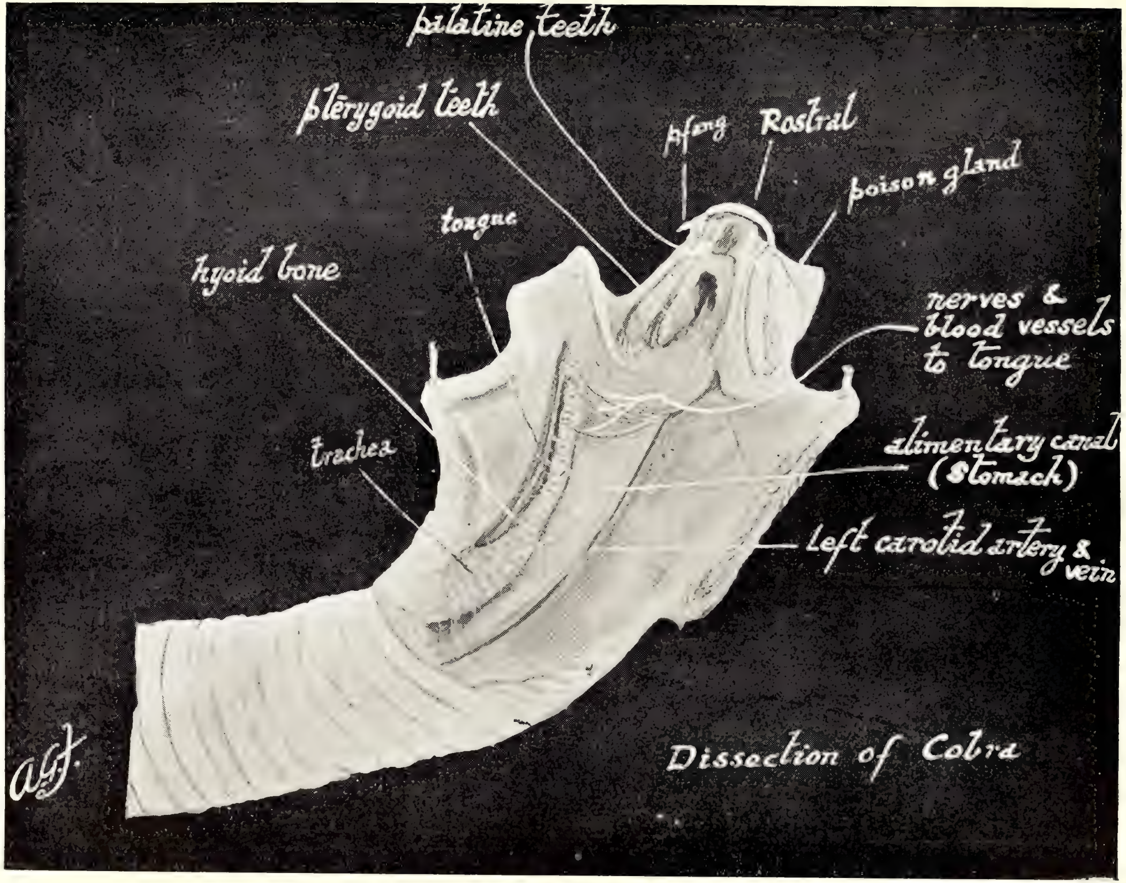
[1] Fairley (N. Hamilton), 'Snake Bite: Its Mechanism and Modern Treatment', *Proc. Roy. Soc. Med.* (June 1934), vol. xxvii, No. 8, pp. 1083-91 (Sec. Trop. Dis. and Parasit., pp. 45-53).

[2] *Tropical Diseases Bulletin*, vol. xxxii, No. 5 (May 1935).

PLATE V.


palatine teeth
pterygoid teeth
fang
Rostral
poison gland
tongue
hyoid bone
nerves & blood vessels to tongue
trachea
alimentary canal (Stomach)
Left carotid artery & vein
Dissection of Cobra
AGJ.

Dissection of head of the Cobra (*Naia naia*, Merr.).

TABLE V.—SHOWING THE COMPARATIVE LENGTHS OF THE MAXILLARY AND QUADRATE BONES OF THE COLUBRIDAE FOUND IN DEOLALI.

(Measurements in Centimetres.)

Species	Length of Skull (cm.)	Length of Maxilla (cm.)	Length of Quadrate (cm.)
Proteroglypha			
Callophis trimaculatus (Daud.)	0·5½ 0·5	0·1 0·1	0·1 0·1
Bungarus cœruleus (Schn.)	2·5 2·1 1·2	0·5 0·4 0·3	0·4 0·3 0·2
Naia naia, var. *caeca* (Merr.)	2·4 2·3 2·2 2·1 2·0	0·6 0·5 0·5 0·5 0·4	0·9 0·8 0·8 0·8 0·8
Opisthoglypha			
Dipsadomorphus trigonatus (Schn.)	1·5 1·4 1·4	0·8 0·7 0·7	0·6 0·5 0·5
Dryophis mycterizans (Linn.)	2·3	1·3	0·5
Aglypha			
Oligodon tæniolatus ((Jerd.)	0·9 0·8 0·7	0·3 0·3 0·2	0·2 0·2 0·2
Oligodon arnensis (Shaw)	1·1 1·0	0·5 0·4	0·2 0·2
Lycodon aulicus (Linn.)	1·5 1·3 1·0 0·9 0·8	0·6 0·6 0·4 0·4 0·3	0·3 0·3 0·2 0·2 0·2
Rhabdophis stolatus (Linn.)	1·3	0·7	0·4
Mocropisthodon plumbicolor (Cantor)	2·0 1·9 1·8 1·6	1·1 1·0 0·8 0·7	1·1 1·0 0·9 0·8
Nerodia piscator (Schn.)	2·4 1·9 1·1	1·4 1·0 0·6	0·9 0·5 0·3
Zamenis fasciolatus (Shaw)	1·9 2·2	0·9 1·0	0·5 0·6
Coluber helena (Daud.)	2·5 2·0	1·6 1·5	0·6 0·6
Ptyas mucosus (Linn.)	3·4 3·2	1·9 1·9	1·3 1·1

TABLE V.—COMPARATIVE LENGTHS OF THE MAXILLARY AND QUADRATE BONES—(*Continued*).

Species	Length of Skull (cm.)	Length of Maxilla (cm.)	Length of Quadrate (cm.)
Colubridæ extraneous to Deolali			
Ohpisthoglypha *Dipsadomorphus beddomei* (Wall)	1·5	0·8	0·6
Aglypha *Polyodontophis collaris*	1·5	1·0	0.7
Boidæ found in Deolali			
Eryx conicus (Schn.)	2·5 1·8 1·3	1·3 0·9 0·6	0·6 0·4 0·3

In the above Table, it will be observed that there are variations in the lengths of the maxillary and quadrate bones, even in the same species. It may not be remarkable, but it is none the less significant that the *Thanatophidia* should head the list by the possession of comparatively smaller maxillary bones. The evidence in these figures definitely confirms the findings of Dr. Fairley and small maxillary bones appear to be a specialization in the snake determining its biting efficiency. In the figures shown for the Cobra, it follows that the younger snakes would be able to project their fangs much more forward and therefore become capable of more effectively injecting a lethal dose than could the older ones in whom the lower maxillary index functions less efficiently. This also supports and explains Dr. Lamb's[1] estimate (quoted by Col. Wall, 1928) that 30 per cent of Cobra-bitten subjects escape with a sub-lethal dose.

EXPLANATION OF LETTERING ON PLATES III AND IV.

ana,—Anterior neural arch. aps,—Anapophysis. ac,—Acetabulum centrum. ar,—Articular ramus. ar, R,—Articular surface for rib. bo,—Basi-occipital. bs,—Basi-sphenoid. cr,—Cervical rib. cor,—Coronoid. c,—Centrum. cv,—Cervical vertebra. ca,—Columella auris. d,—Dentary. eo,—Exoccipital. epg,—Ecto-pterygoid (or transpalatine). ec,—Epiphysis centrum. f,—Frontal. fm,—Foramen magnum. fo,—Fenestra ovalis. fr,—Fenestra rotunda. fvn,—Foramen for 5th nerve. hs,—Hypapophysis. hp,—Haemal process. im,—Intermaxillary (praemaxillary). irp,—Inferior rib process. lf,—Lacrymal foramen. me,—Mandible. m,—Maxillary. md,—Mastoid. mp,—Metapophysis. ns,—Neural spine. na, a,—Neural arch alae. of,—Optic foramen. oa,—Orbital aperture. odp,—Odontoid process. od,—Odontoid. og,—Orbital groove. pl,—Palatine. pg,—Pterygoid. prf,—Praefrontal. pf,—Postfrontal. pc,—Periotic. przs,—Praezygapophysis. ptzs,—Postzygapophysis. pna,—Posterior neural arch. p,—Parietal. q,—Quadrate (tympanic). rfg,—Reserve fang. s,—Squamosal. sg, or gs,—Gland sulcus. sp,—Sphenoid. so,—Supra-occipital. srp,—Superior rib process. tu,—Turbinal. tp,—Transverse process. t,—Temporal. v,—Vomer.

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[1] 'The Poisonous Terrestrial Snakes of our British Indian Dominions, etc., etc.', by Col. F. Wall, I.M.S., K.H.S., C.M.Z.S., p. 75 (1928).

A NEW CARTON-BUILDING SPECIES OF ANT IN SOUTH INDIA

CREMATOGASTER DOHRNI ARTIFEX, MAYR.

BY

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(*With four plates*).

Introduction.

This remarkable species of arboreal ant was discovered by the writer for the first time in S. India in the Sirumalai hills in the vicinity of Dindigul town at an elevation varying from 2,500 ft. to 3,000 ft. While on a brief visit to those tracts with a party of Agricultural Students, early in January 1935, these insects attracted his attention by the huge globular dark brown nests, about the size of a foot-ball, attached to branches of various trees on either side of the track at a height of about eight to nine feet from the ground. Those spherical enclosures were conspicuous in appearance and were built round and embracing some fairly stout and healthy branches of certain trees. Besides the larger branches, several smaller ones passed right through the nests giving them additional support. The nests, which were full of ants at the time of collection, were singular both in the material used in construction and in their architecture; and the writer was naturally struck with admiration at the wonderful foresight and great ingenuity displayed in their construction.

The inhabitants of these curious nests are neither large nor attractive in appearance. The ant concerned is comparatively a very small one, ferrugineous in colour and varying in size from 3 to 5 mm.; but it is certainly one of the most skilful and talented of all the tribes. The head is somewhat larger and square and the thorax is provided at the hind part with a pair of prominent sharp spines. A slender nodulose waist or pedicel connects the flat triangular abdomen to the thorax. The abdomen itself is a shade darker than the rest of the body and is often held bent over and between the spines. The body has a thin covering of abundant fine silky pubescence. So far as is known there is no published record of this species in S. India and probably this is the first record of its occurrence in this country.

Since very little is known about this species of ant an attempt was made to make a thorough study of its biology and habits. With this end in view fresh nests were obtained from the same locality and were kept for observation and study for months together. Some experiments were also conducted to elucidate the natural history of the species concerned.

THE NEST.

In South India the species is probably confined to the Sirumalai hills since no records of its capture from any other locality are to be found. The nests are fairly abundant in the wooded parts of those hills. They are very nearly globular enclosures built around branches. Generally the site chosen for their construction is at a point where one or more branches diverge. The main branch around which the nest is built does not necessarily run through the middle of it, and rarely exceeds 1½ in. in diameter. Several smaller branches are often included in the formation of the nest and these vary in diameter from $\frac{1}{10}$ to very nearly ¾ of an inch. The supporting branches are all sound and healthy and bear good green foliage, and, therefore, no direct damage is apparently caused to that part of the branch where the nest is located.

Shape and colour.—The nests are generally globular, subspherical or ellipsoidal, but may vary from oblong to cylindrical in some exceptional cases (photographs). They are good, solid nests having the appearance and colour of decomposed and dried cow-dung. The general colour is dusky or dark brown with the hardness and consistency of crude card-board.

Size.—The largest nests are about the size of an ordinary football the maximum length and thickness noted being 12 and 9 in. respectively; but there is a considerable range of variation in size and in shape. The following measurements of half a dozen nests may furnish a good idea of the extent of this variation.

Shape	Length	Thickness
1. Largest size, more or less ovoid (Pl. I)	11½ inches	9¼ inches
2. Elongate cylindrical, one end broadly rounded and the other less obtusely rounded	12 ,,	7 ,,
3. Ellipsoidal nest Fig. 2	7½ ,,	5½ ,,
4. Medium size—oblong	11 ,,	6 ,,
5. Small round—subspherical ...	6 ,,	5 ,,
6. Small size, slightly damaged ...	4 ,,	3 ,,

External Architecture.—The nest is made up of a multitude of thin rough, very often leaf-like sheets, composed of a material which has the appearance (as mentioned already) of dried cow-dung. The outer envelope is more or less uniform, but at irregular intervals on the surface there are numerous convex bulges in the form of irregular blisters. These blisters or projections, on careful examination were found to be eave-like extensions with small arched openings on their under surface. These openings are gateways for the ingress and egress of the ants; they are

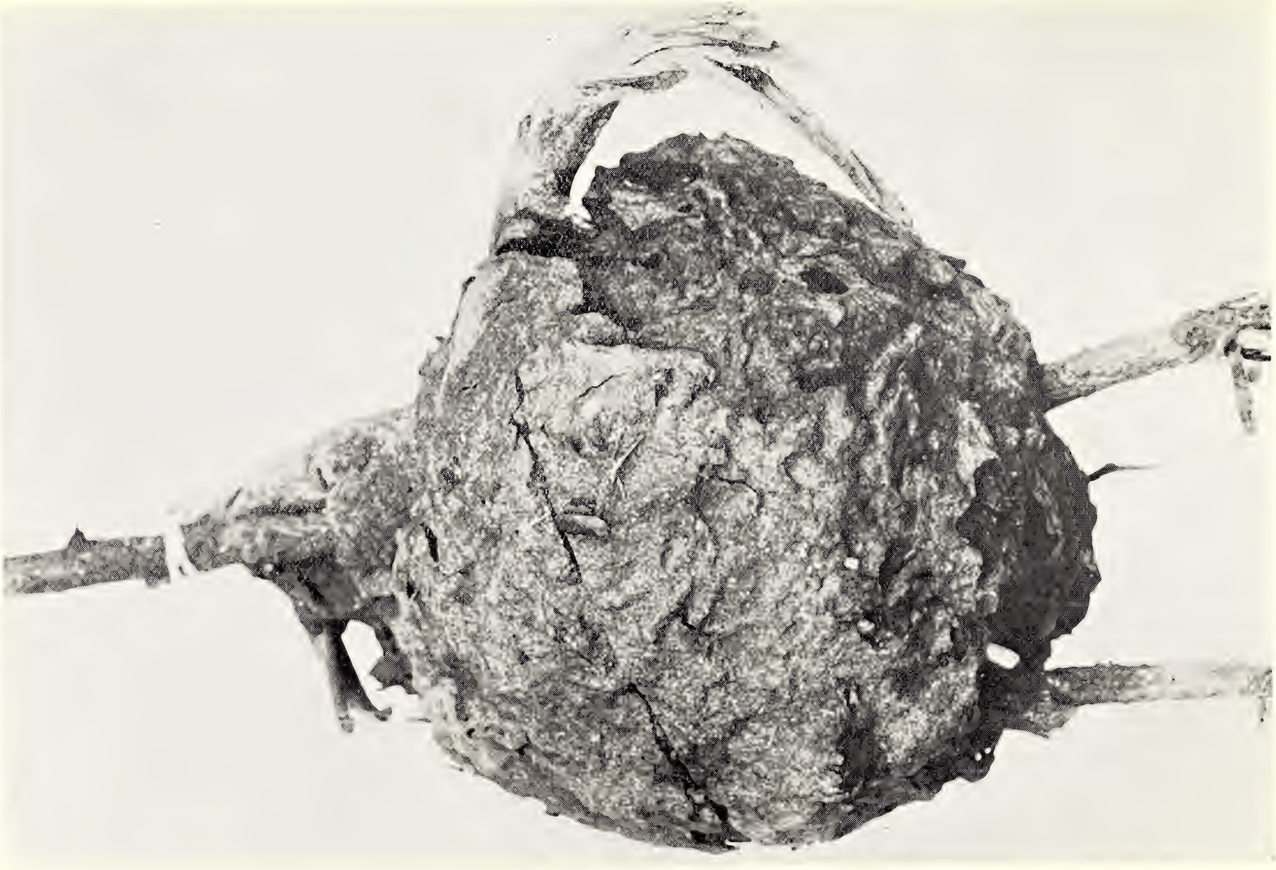

Fig. 1.—Carton nest of *Crematogaster dohrni artifex,* Mayr.

semicircular, but present no regularity in size or shape. They vary in size with a width and height ranging from 3 to 8 mm. and are big enough to allow the passage of half a dozen workers as also the winged sexual forms. The outer sheet or covering may not be entirely continuous and unbroken all round the spherical body of the nest. The upper portions may have a stronger and thicker covering due to the presence of more than one layer of convex sheets extending irregularly down the surface. The convex elevations and apertures are generally less numerous on the upper surfaces. This covering is nearly as efficient as the rest of the nest both in durability and hardness. On making a slight breach in the outer envelope, the interior of the nest is seen to present somewhat the appearance of a large sponge built out of several layers of leaf-like sheets. These convex sheets are arranged one over the other with interspaces enclosing a comb-like mass of passages and a labyrinth of covered ways leading in different directions. This arrangement may be compared to the irregular old-fashioned piling of heaps of tiles on the roofs of Indian houses.

Internal architecture.—A vertical or transverse section carefully cut through the nest by means of a fine small saw will reveal the nature of its internal structure (Photograph Fig. 3). The interior is seen crowded with irregular anastomosing galleries comprising small halls and corridors varying from 2 to 9 mm. in diameter. They lead in different directions and are formed by side walls and partitions built of the same material as the nest disposed in thin layers. Not infrequently a whole or portion of a dried leaf is taken advantage of to assist in making this labyrinth of chambers. Occasionally such leaves are covered or coated with this papery material. These galleries and chambers are the abodes of the members of the community and the nurseries of their brood wherein all functions and activities of the community are carried out. From an examination of a number of nests and their internal chambers it would appear that there are no separate specialised chambers for the different categories or castes of the colony. But this much can be ascertained, generally the eggs and young larvae are distributed more towards the inner recesses and the pupae and the teneral adults are located near the outer chambers, passages and halls. The winged males are also met with in chambers near the periphery of the nest. The queens and workers throng the interior of the entire nest. No specially enlarged cells or chambers, set apart for queens, were noticed. In these and other respects the mode of architecture and allocation of quarters differ from certain other groups of social insects like bees or termites.

Nest material.—The 'carton' manufactured by the ants for building their nests is a combination of several substances. A variety of raw material is used in the making. Wood scrapings, dust, fibre, leaf particles, scraps of bark, a little earth, and grains of sand all apparently go into its composition. The sharp mandibles and other mouth parts of the ants are the machinery employed in its manufacture. The raw material is chewed and with the help of a secretion from the salivary glands worked up into a kind of paste; probably faecal and proctodial matter are also employed in the mixture. Thus is produced the woody composition, sufficiently hard and strong when dry, with which the nests are built. It is a hard compact material, which though somewhat brittle, yet retains some flexibility which it owes probably to the glandular secretions which enter into its composition. On the whole the 'carton' is more or less proof against rough weather. The nests withstand the rain though the outer layers become softened. That these nests are weatherproof was fully demonstrated by the nests experimentally grafted on to trees in the College grounds where they were exposed to the full force of the monsoon. The inhabitants equally survived the complete immersion of their nests in water.

The 'carton' has been subjected to a process of chemical analysis[1] and the following account may provide additional data as to its composition:—

1.	Moisture	10·00
	Dry basis	
2.	Loss on ignition—organic matter	81·20
3.	Insoluble mineral	2·77
4.	Soluble mineral matter by difference	16·03
	Total ...	100·00

Qualitative tests carried out with an hydrochloric acid extract indicated the presence of the following acids and bases among others:—

1. Phosphoric acid (P_2O_5.)
2. Sulphuric acid (SO_3).
3. Iron and Alumina ($Al_2O_3 + F_2O_3$).
4. Lime (CaO).
5. Potash (K_2O).

About 80·1 of the total dry matter of the nest consists of organic matter and it is probable that very nearly the whole of it is derived from plant materials such as leaves, twigs, bark etc. About 80·85 per cent. of the total mineral matter is acid soluble and the rest comprises insoluble sand. The fact that sand forms such a small fraction of the total mineral matter may suggest that the minerals are all derived from vegetable matter alone and no earth as such enters into the composition of the nest material. The material is strong, tough and hard and is insoluble in water.

The flakes comprising the material of the nest are hard, firm and strong though brittle. The material from which they are built appears to be impervious to water vapour or even to water. Two pieces of carton taken from a nest were placed in test tubes where one flake was brought into direct contact with the water and the other suspended above it so that the aqueous vapour might affect it. At the end of 24 hours there was no appreciable change in the weight of the flake suspended above the water while the flake brought into direct contact with the water showed a very slight loss. The experiment indicates a high degree of compactness and the absence of porosity in the carton despite its apparent thinness. The waterproof condition of the carton may arise from a coating of the glandular secretion applied by the ants over its surface and the secretion thus forms a cement-like coating which protects the nest during the continuous rains of the monsoon.

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[1] The writer is indebted to Mr. Varahalu, Assistant to the Agricultural Chemist, for the chemical analysis and his thanks are herein recorded.

Tests with the following reagents on the flakes as also on powdered material were conducted:—

1. Dilute caustic potash—decinormal solution.
2. Dilute sulphuric acid—decinormal solution.
3. Water (hot and cold).
4. Sulphuric ether—decinormal solution.
5. Ethyl alcohol (98 per cent.).
6. Chloroform.
7. Carbon disulphide.
8. Acetone.
9. Benzol.
10. Nitrobenzene.
11. Pyridine.

After continuous shaking, these were kept overnight. They were filtered subsequently and the residues left over after evaporating the filtrates showed the presence of (1) vegetable colouring matter, (2) fats and waxes. Of the numerous solvents tried, pyridine extracted the largest amount of these substances from the material. This was highly resinous and extremely sticky. While shaking with pyridine, the material gradually tended to disintegrate and soften. It lost its original firmness. No such changes were however observable in the case of the other solvents. This points to the fact that the cementing secretion of the material is pyridine soluble. Neither dilute sulphuric acid nor water, hot or cold, softened the material. It retained its firmness even after 48 hours of soaking. Caustic alkali caused (1) the swelling of the material and (2) the gradual dissolution of it.

Construction.—The actual process of nest construction has not been observed. The workers, after selecting a suitable building site on a branch, probably spread the paste-like material in thin layers and so gradually build up their globular nests. The labour involved appears formidable but the industry and co-operation of myriads of workers finally produce a structure which cannot but rouse our admiration. Together they collect the raw substances and by their combined industry produce the most efficient non-conducting building material which is proof against the elements, and with this product they build themselves an edifice which is both a fortress and a home—suited to all their requirements.

Trees infested.—These exclusive tree-dwellers seem to be partial to a few trees commonly occurring in these hills as may be gathered from the statement furnished below. Among these the *Valichai* tree appears to be a particular favourite as may be inferred from the number of nests occurring on it as also from the maximum size these attain.

Scientific name	Vernacular name	Locality	Remarks
Gardenia lucida Roxb.	Valichai ...	Serumalai ...	Nest fairly common on branches, largest sized
Aphania bifoliata Radlk.	Kookaimuthu ...	,,	Less common
Ochna squarrosa Linn.	Chilandi ...	,,	Occasionally found
Ixora parviflora Vahl.	Kurachushundu.	,,	

OTHER KNOWN CARTON-BUILDERS.

Suspended carton nests are known to be built, according to Wheeler, by many species of ants all over the world and these mainly belong to the genera *Camponotus*, *Polyrhachis*, *Azetica*, *Dolichoderes*, *Crematogaster*, *Macronischa*, *Myrmecaria* and *Tetramorium*. Among these the genus *Crematogaster* includes the largest number of carton-building species.

Name of species	Locality	Authority
C. ranavalonæ	Madagascar island	Forel.
C. tricolor	,,	,,
C. schencki	,,	,,
C. inconspicua	Africa	
C. marginata		
C. stadelmanni		Mayr.
C opaciceps		
C. hova		
C. peringueyi		
C. montezumia		Smith
C sulcata	Tropical America	
C. ramulinida		Forel
C. sholli		
C. lincolata		

In India the only species so far noted to be carton-builders are *C. kerbyi*, *C. rogenhoferi* and *C. ebeninus* referred to by Rothney, Wroughton and Mayr. The species of ant under discussion *C. artifex* has been recorded as a carton-builder in Siam and Singapore by Mayr. The writer has not come across any record of this species from S. India.

Crematogaster dohrni artifex, Mayr.

The species concerned is *Crematogaster* (*Acrocoelia*) *dohrni artifex* Mayr. It belongs to the sub-family *Myrmecinae*, tribe—*Crematogastrini*, genus—*Crematogaster*, sub-genus—*Acrocoelia*, species—*dohrni* Mayr., sub-species—*artifex* Mayr., *Verh. Zool.-Bot. G.E.S. Wien*, vol. xxviii, p. 682 (1878).

Distribution.—This appears to be the first record of its occurrence in S. India and probably in India. As stated already the species has been recorded by Mayr. as occurring in Siam and Singapore.

The genus *Crematogaster* is a large one and comprises a number of species which are distributed over the whole of the warmer parts of the entire world. They possess the most varied habits. Some five species have been noted by the writer in S. India as common—*C. rothneyi*, *C. contempta*, *C. subnuda*, *C. anthericina*. But all these are quite different from the species under discussion particularly in their life economy and nesting habits. The species *C. rothneyi* is a near ally of *C. artifex* in structure and size, but entirely different in its nesting habits. The former

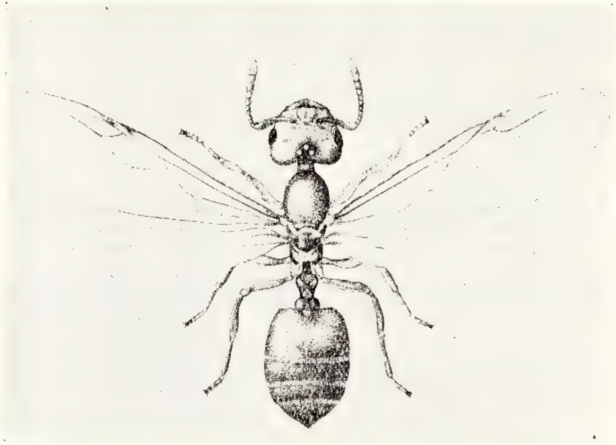


Fig. 1.—Queen.

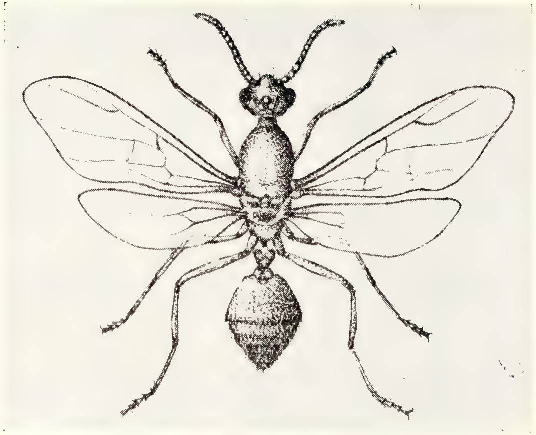


Fig. 2.—Male.

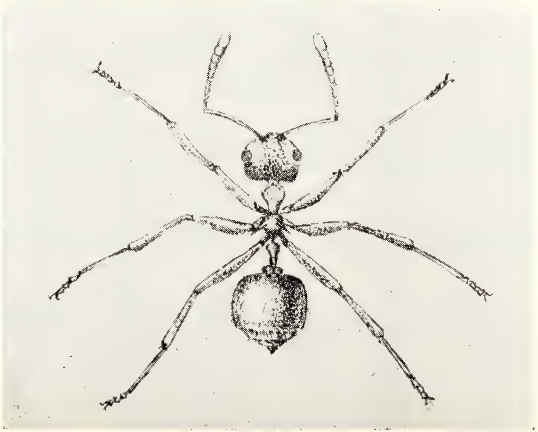


Fig. 3.—Worker major.

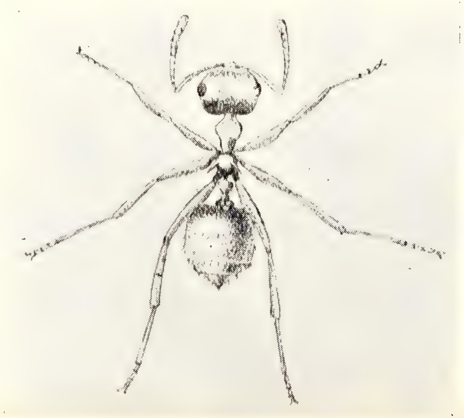


Fig. 4.—Worker minor.

Crematogaster dohrni artifex, Mayr.

occurs in houses, gardens, plants and in a variety of other situations; but the nests are always found in the soil or in crevices in the walls of buildings at a depth of 3 or 4 in.

Members of the Community.

There are three distinct types or castes of individuals in the colony: (1) the *females* or *queens*, (2) the *males*, and (3) the *workers* along with the immature forms, i.e., the larvae and pupae of each of these. The three adult castes differ much in size, structure and habits. The workers consist of two types—the worker major and the worker minor. The workers possess no noticeable difference either in structure or habits, but show a slight variation in regard to size.

The Queen (Pl. II, fig. 1).

There are two forms: the winged females and the dealated ones; but the latter are rather rare as the wings are retained during the greater part of their lives. The female is a well-developed robust individual and is comparatively much larger than the males or workers.

Length 8·5 mm. to 9·2 mm. with ovipositor extended; width in abdomen 2·5 mm. to 2·75 mm.; wing expanse 1·55 mm. to 1·62 mm. The general colour of the female is similar to that of worker, being dark yellowish brown with dorsal aspec of head and thorav fuscous. The ocelli are clear and transparent. The abdomen is large and massive and is deep dark brown towards apex. The ovipositor is just visible and not inconspicuous.

Head.—deep dull yellow—shining occiput—high—rounded slightly less broad than anterior margin. *Antennae.*—moderately thick covered with short soft hairs 11-jointed—scape gradually broadening towards end. *Flagellum.*—gradually thickened to apex with a distinct club of three terminal segments. *Eyes.*—dark, placed about middle on the sides of head. *Ocelli.*—distinct, transparent. *Mouth parts* (figure).—comparatively large. *Clypeus.*—broad with anterior margin very nearly straight. *Mandibles.*—thick and stout, shorter than those of ♀, possess 5 teeth not so pointed as in ☿—the apical one longer than rest folding closely into head with outer margins visible. *Maxillary and labial palps.*—shorter and often thinner than of ☿. *Thorax.*—Pronotum more or less depressed beneath large convex mesonotum which overhangs the prothorax anteriorly but not completely. *Metanotum.*—oblique with a pair of very short stout thick spines—just visible—tips of spines dark. *Pedicel.*—not long—first joint broadened with rounded spines, concave from side to side and anteriorly, transparent yellow, second joint dark yellow with a narrower squamiform node rounded above. *Abdomen.*—much larger than that of ☿. Sub-cordate darkening towards apex, ovipositor just visible. *Wings.*—hyaline, cells indicated by yellowish nervures.

The number of queens present in a healthy active normal colony may vary within considerable limits. The number is comparatively high even in normal times. As many as fifty-nine winged females have been recovered from a colony. Queens are continuously developed probably in all months of the year, as was seen from nests kept under observation for nearly eight months. But the highest emergence takes place in April. On emergence the queens frequently wandered out of the nest in search of food and fed on the honey or jaggery syrup provided for them. From several trials it was found that the reproductive capacity of each female seems to be limited and is generally considerably less than in most of the other species. This notwithstanding, the community is one of the most populous. This has to be accounted for more by the multiplicity of queens than the individual rate of oviposition. Under artificial conditions, the winged female on emergence or after did not exhibit any great tendency to flight. In nature this may be different. But it is inferred from their habits in captivity, that the marriage flight itself takes place within the vicinity of the nest, and the majority of queens probably return after fecundation to the parent nest. That fertilisation can take place outside the nest is made clear from the fact that such females have been seen to produce fertile eggs. The winged females attended by workers frequently emerge from the nests during cool morning hours and also in the evenings. This tendency was markedly observed in certain cages in the laboratory in which the exits were not well secured thus permitting one or two queens accompanied by workers to escape and wander about. Like the workers the queens are impatient of drought and move from one side of the cage to another or to a wet sponge for the sake of moisture.

Food.—A queen can attend to her toilet without the assistance of the workers but rarely seeks her own food when in their company. When solitary she has been observed partaking of liquid food in the shape of honey or sugar syrup, as also to attack and catch a soft-bodied quiet termite nymph. When in the company of workers a queen is fed by her attendants, the process of feeding is effected by a mutual application of the mouth parts. She exhibits another striking tendency. She apparently is fond of proctodial matter exuded by the workers. She forcibly holds the gaster of a worker with her front legs and applies her mouth parts to the tip, the while gently stroking the abdomen with her antennae tickling the creature to induce the flow of the liquid coming out of the anus. This is rather a common proceeding among ants and in the present instance appears to be a modification of the habit of milking 'ant cattle'.

Behaviour.—Though several queens were kept together in separate cages or in slices of nests with and without a retinue of workers there was a complete absence of any hostility. They lived together in peace and amity, often congregating together huddled up in a family circle. Even queens from different nests were not antagonistic. But it was frequently observed that workers of a particular nest never tolerated the presence of an alien queen. Such intruding queens were mercilessly attacked and killed.

Fecundity.—In the queens fecundity appears to be comparatively low. To test their egg-laying capacity several queens were isolated in artificial cages, with or without workers. They were provided with sufficient moisture and food in the shape of honey or sugar syrup. Eggs were never laid till after six or seven days after emergence. The maximum number laid by a single queen per day never exceeded 3 or 4. In about a dozen observed cases the total number of eggs laid by a single individual never exceeded 21. A few queens were dissected under a binocular microscope seven days after emergence to gain some idea of individual egg-laying capacity. The number of eggs in various stages of development in the ovaries was found to be fairly constant for three individuals so tested. It varied from 42 to 46 averaging 44. When unattended by workers the queens collected eggs if scattered and shifted them from place to place often under or over a wet sponge; but such eggs fail to hatch in the absence of workers.

Founding new colonies.—It may have been apparent from the description of the nests and the elaboration of the material for their construction that the queens, though large-sized, may not by themselves be able to establish new colonies. The ordinary mode of founding a nest is probably by a process similar to 'swarming' in the case of honey bees, i.e., a certain contingent of workers headed by a queen or a number of queens may leave the parent colony and emigrate to new and suitable places to establish a separate colony. That this may be the usual method is strongly suggested by the continual marchings of an army of workers presided over by two or three queens after escaping through cloth coverings from artificial cages in the laboratory.

Longevity.—The longevity of the queens in isolation or in company with workers was tested in several cases. In each instance a plentiful supply of food in the shape of termites or maggots and honey or sugar syrup was provided. The maximum life span under these conditions never exceeded 58 days in April (9th April 1935 to 5th June 1935). The queens generally retain wings either throughout life or at least for 30 to 35 days. In rare cases the wings were pulled off by workers earlier.

Males (Pl. II, fig. 2).

These are feeble insects, slender, delicate and winged. They are much smaller than the workers. Length 3·5-3·75 mm.; width 1·0 mm. across thorax (the broadest part of body).

The whole body is covered with smooth erect hairs. The general colour is dull yellowish brown. Head smaller and a shade darker than thorax, with large and prominent eyes placed high on sides of head. Ocelli clear and transparent. *Antennae* 12-jointed; scape very short. *Flagellum* without club, the last joint much longer than the rest, first joint rounded in form (globose). *Mouth parts* (fig.) delicate. *Mandibles* slightly rounded below—conical—and more or less tapering. *Apex* with a minute cleft. *Maxillae* and *labium* comparatively larger. *Thorax* very similar to ♀ but completely devoid of spines and legs are very delicate. *Pedicel* more or less similar to ♀, second joint transversely oval. *Abdomen* of a deeper yellow brown, abdominal tip not pointed as in ♀. Genitalia present and visible and well defined (fig.) consisting of the usual parts. *Wings* hyaline but not as glassy as in ♀. Nervures yellowish.

The males on emergence are not active. They are often dragged about and harassed by the workers, who sometimes forcibly pull off the wings and carry them about between their mandibles. The males are often attacked by ectoparasites in the form of small mites.

Longevity.—The males are shortlived and have not been observed to imbibe any food. Maximum period of life observed in cages is 11 days.

Workers (Pl. II, figs. 3 & 4).

Description.—The workers are of two types, worker major and worker minor. These are structurally more or less identical with slight differences in size of head, thorax, antennae but the main difference is only in size.

☿ major 4·10-5·11 mm.; ☿ minor 3·25-3·82 mm.

The larger workers are at least twice as numerous as the smaller ones. Both the forms are equally active and industrious sharing and attending to the duties of the colony.

The worker is a dark reddish brown insect with the abdomen varying from dark to dark brown. The body is very nearly covered with whitish hairs fairly long. The head is approximately square in shape with an indistinct trace of fine longitudinal striations.

Mouth parts.—Mandible long with five sharp teeth; maxillary and labial palps somewhat longer than those of ♀♀ or ♂♂. The worker major has a slightly broader head than the minor. Antennae distinctly clubbed at the tip. Eyes placed at sides of head. *Thorax.*—The metanotum is rather broad with long pointed divergent spines directed backwards. Abdomen flat and broad with the sting conspicuous. Stylets sharp tapering and very fine at the tip.

Longevity.—Workers are comparatively shortlived. They lived on an average for about 5 to 6 weeks in captivity. The maximum period noted in isolated cages was about 7 weeks.

IMMATURE STAGES AND LARVAL ANATOMY.

Oviposition.—Several queens were isolated in cages for recording their egg-laying capacity with and without workers. Eggs were laid by queens even when unattended by workers. Hence it is inferred that no special oviposition stimulus is derived from the presence of workers; but the eggs invariably fail to hatch in their absence. The queen takes some care of the eggs but even then they get mouldy. Eggs were laid singly, and were glued on to glass surfaces, corks or even cloth plugs. The number laid by an individual per day is generally 3, but occasionally 4 may be found. Egg-laying was never observed earlier than at least 7 days after emergence. The maximum number laid never exceeded 21 by any single individual in artificial cages; but it varied from 18 to 21 in the month of April for 11 individuals under observation. The queen continues to lay eggs for 6 or 7 days with irregular breaks.

The egg.—It is nearly white in colour, elliptical, slightly thickened in the middle; ends obtuse rounded, one end a shade narrower. The surface is lustrous indistinctly shagreened under high-power microscope. Chorion—elastic with no markings other than a longitudinal white streak (Pl. III, fig. 1).

Length 0·46-0·52 mm. average being 0·47 mm. for 40 specimens. Average thickness in middle region 0·27 mm.; broad rounded end 0·27 mm.; other end 0·255 mm.

Incubation period.—The incubation periods of the eggs in artificial cages with queens and workers were noted for quite a large number during April and May 1935. The incubation period varies considerably if the cages are not provided with sufficient moisture to make conditions of incubation entirely favourable; but

Crematogaster dohrni artifex, Mayr.

Egg

Fig. 1.—Egg.

Larvae

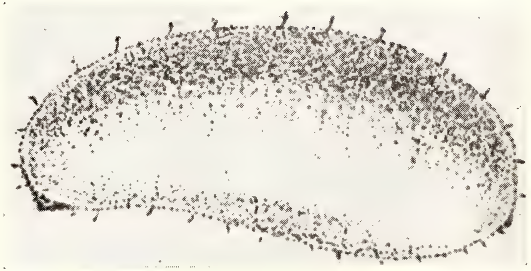
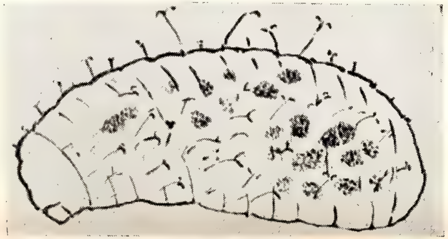


Fig. 2.—Queen larva (fullgrown).



Pupae

Fig. 4.—Queen Pupa.

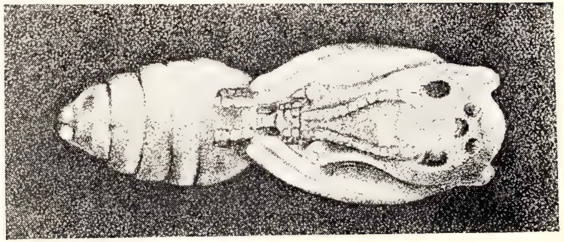
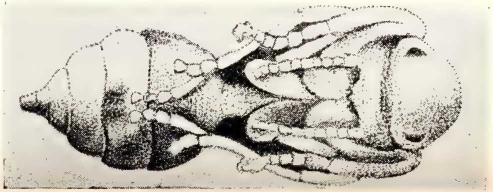


Fig. 5.—Male Pupa.



it is generally short, about four or five days. The eggs seem to show a state of growth just before hatching. Towards the beginning of the third or the fourth day colour slightly fades, but not very perceptibly. The egg now assumes a dull creamy tinge and the larvae may be discernible through the thin chorion under the microscope.

Larva.—Upon hatching the larva is hardly larger than the egg and remains curved for a short while. It closely resembles the larvae of other species of the genus and has much in common with the grubs of the family. As is usual with the family, the grubs are soft apodous, vermiform, glassy covered by a transparent membrane having a small conical projection marking the narrower anterior end and slightly broader approximately straight hind end. The usual 13 segments are not clearly marked at this stage. Like other larvae they are incapable of exertion. They possess a sparse covering of small rigid hairs projecting from minute tubercles or elevations on the integument, which are helpful for providing easy transport. Some of these hairs show a tendency to be tipped or incipiently forked (Pl. III, fig. 3).

The young larvae are fed by the workers on liquid disgorged food and the diet of the older ones probably includes bits of solid substances in addition. In cages provided only with vegetable food, grain, syrup, etc., the development of the larvae appeared to be slow and delayed. The quantity and the quality of the food effect changes and produce irregular growth in the larvae. After the fourth or fifth day it is easy to tell a queen grub from a worker one by the size and growth (Pl. III, fig. 2).

The older worker larva.—Length 1.05 mm.; width 0.64 mm. These worker grubs at this stage are covered with different kinds of hairs which can be classified under five distinct kinds. Some hairs are simple. Others are tipped; still others are forked. The majority are furcate or tipped with a double hook so that they look like miniature anchors. A few are imperfectly anchor-shaped. The hairs are about 1/20th of the width of the larvae.

The full-grown worker larva possesses only a few scattered hairs. Length 2.60-2.75 mm.; width 1.0 mm.

The queen larva.—The full-grown queen larva is much stouter and longer in size and is dull creamy white in colour. It is almost smooth save for sparse minute hairs. Length 4.9-5.2 mm.; width 2.2-2.5 mm. The mass of meconium is only indistinctly visible in these grubs (Pl. III, fig. 2).

The grubs of males have not been identified as such by the writer.

Pupa.—When full grown the larva discharges as usual the meconium and passes on to semi-pupa stage. Unlike the larvae of *Camponotus* these grubs transform themselves into pupae without a cocoon. The pupae are naked and in this stage the various castes including worker major and minor are easily distinguished by size, appearance and colour.

The queen pupae (Pl. III, fig. 4) are dull creamy white in colour and are comparatively in size. Length 7.1-7.4 mm.; width 2.1-2.3 mm.

The male pupae (Pl. III, fig. 5) are a little shorter than those of the workers; but more robust at the thorax with developing wings. They are easily distinguished from worker pupae not only by colour, size and the presence of wings; but also by the distinct visibility of three ocelli and pinkish eyes. Length 2.9-3.2 mm.; width 1.21-1.35 mm.

The worker pupae (Pl. III, fig. 6) are dull dirty white, sometimes greyish white to slight brown in colour. Length 3.6-3.75 mm.; width 1.1-1.20 mm.

The worker, queen and male pupae are in the earliest stage whitish in colour and devoid of any markings except the reddish eye spots. As they develop they assume a shade of brownish yellow which gradually deepens. They are devoid of any cocoon and the thin fragile pupal skins are shed when the callow emerges. These pupal skins are seen to be easily disposed of by workers, probably devoured.

The Callows.—The callows or newly-hatched workers are yellowish white which changes to medium brownish yellow and soon after to brown or dark brown. They take a little over two days to assume the adult colouration. The helpless callows are not entirely idle during the period. They are not strong enough to undertake the labours of foraging or defence; but the instinctive obsession of nurture of the brood is displayed by them. Some time after emergence, they have been seen to shift the eggs and larvae as also to constantly lick them with their soft mouth parts.

LENGTH OF LIFE CYCLE AND DEVELOPMENTAL PERIODS.

The total period of the life cycle varies very much not only in the different castes but also in the same caste according to conditions of temperature, humidity and food supply. Several experiments in artificial cages were conducted to gauge the period of the egg, larval and pupal stages and a regular and systematic observation of about six complete nests was continued in the laboratory for nearly eight months. From four to five broods were reared in the nests beginning from the middle of January. The one essential condition was to keep one or several queens and a number of workers along with the eggs and larvae as otherwise the eggs fail to hatch and the larvae do not mature. Another factor equally important is to provide as nearly natural conditions as possible including the quality and the quantity of food supplied. Several separate trials of isolation of a known number of workers with a queen or two introduced in a small slice of an empty and cleaned nest were carried out and the total minimum period for the emergence of a fresh brood of workers was noted. Since the development period of the larvae is difficult to determine separately, the length of egg stage and pupal stage were separately worked out. In one case eggs were laid on 16th April 1935 and the first emergence of callows was noted on 24th May 1935 and continued up to 26th

June 1935. Thus the period varied in April and May from 38 days to 71 days.

Egg period noted—4 to 5 days.
Pupal period—10 to 21 days.
Larval period—24 to 47 days.

The minimum pupal period of queens has been noted to be 10 to 11 days; but it is almost certain from observation in nests kept in the laboratory that the length of the life cycle is much shorter in nature. It may be even a little less than a month.

SEASONAL VARIATION AND SWARMING PERIOD.

The study and observations of these ants were confined to a period of nearly eight months commencing from January 1935; and hence the account of their seasonal activity is restricted to results obtained during this limited period.

The colonies were noted to be most populous from March to May when the sexual winged forms as well as the workers are found in incalculable numbers. It may be inferred from the presence of a varying number of queens or females at all times, that the females are probably developed in small numbers all through the various seasons of the year as also the worker individuals. From about the middle of March small numbers of winged males begin to emerge and by about the middle of the next month thousands of males are produced. Thereafter there is a slow and gradual decline in numbers till about the beginning of May. From this period males are seen only rarely and in small numbers. Towards the end of March the numbers of winged females begin to show an increase attaining a maximum by about the middle of April. They continue to emerge for about a week. This period, i.e., the end of April appears to mark the peak of emergence and hence the real swarming season and the period of marriage flights are confined largely to this part of the year. From the beginning of May till early June the number of queens produced gradually decreases. Soon after the appearance of queens the production of workers is hastened and the largest numbers are found in May and the beginning of June. After the middle of June the numbers undergo a gradual diminution so that only the normal activities are continued. By about the end of July considerable numbers die and the colony has a precarious existence under artificial conditions. It has been seen that the males put in their appearance early in the field, i.e., about two weeks before the swarming of queens. It is inferred that the queens naturally require a longer period of development than males.

SEX RATIO.

It is difficult to estimate the sex ratio with any accuracy as the winged sexual forms continue to emerge day after day during the swarming season and long after. In order to arrive at some idea of the proportion of the sexes a few swarms of males and females that emerged out of the nests on particular days in the zenith of the swarming season were collected and a few such computations were actually made. The percentage of winged females varied slightly, but was never seen to exceed 3 per cent. of the emerged sexual forms.

HABITS IN GENERAL.

These ants are markedly carnivorous and depend mainly on animal food for their sustenance though they exhibit a partiality for any sweet liquid such as honey or syrup. They were reared for months in the laboratory on a supply of termites or soft fleshy maggots, hairless caterpillars, the flesh diet being varied with an occasional provision of jaggery syrup or honey. Soft bodied insects like termites are their main prey though they will attack small beetles and flies. Their chief weapons of attack are their sharp mandibles. It is said on excellent authority that the sting is rarely used by ants of this genus but the writer's experience to the contrary is based on long and continuous observation in the laboratory. The ants attacked insects introduced into their cages with their sharp and powerful mandibles but if resistance was offered the sting was freely used. The sting is thrust direct into the body of the victim by turning the tip of the mobile gaster or the ant in the accustomed manner elevates its abdomen above its back or head and squirts the acid into the wound made by its mandibles. Occasionally in the scuffle a turbulent termite would get hold of an ant by a leg or an antenna. In its efforts to free itself the ant would bring its sting repeatedly into play, sometimes it was helped by a passing comrade who coming to the rescue equally used its sting as the more effective weapon of attack. In the process of stinging the stylets pierce the soft body of the victim and a minute drop of frothy liquid is injected into the wound. The writer has had personal and intimate experience of the methods of these ants in attack, particularly when collecting their nests from the trees, when the ants dropped like rain upon him, entered his clothing and brought their stings and mandibles into continuous and painful use.

The ants carry their victims into their nest holding them between their mandibles. Foraging parties of workers will bring in live and dead insects of various kinds. They feed on all kinds of animal matter, including the dead of their own species, evincing a trait of cannibalism which is apparent in the spoils conveyed by the workers to their nests. Occasionally a few workers join hands in transporting a particularly heavy object to the nest. Such team work is rare in this species; but in one instance the captives in our laboratory gave a marvellous example of co-operation and team work. Their objective in this instance was some powdered jaggery heaped on a high glass cube in the proximity of the nest. Some of the workers succeeded in climbing the smooth walls of the cube, while the rest crowded round the bottom. The workers at the summit of the cube attacked the pile of sweet stuff, each ant taking a particle between its mandibles, carried it to the edge of the cube and now, instead of descending with their burdens down the slippery surface of the cube, the ants

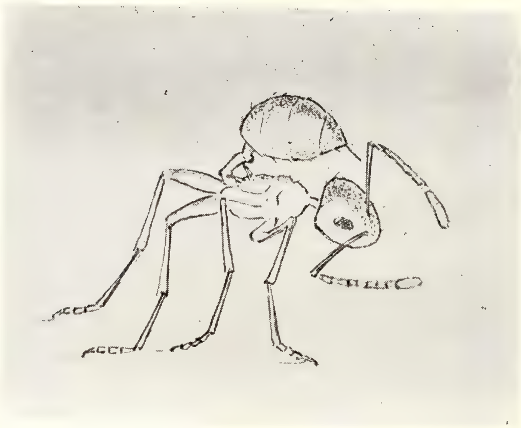


Fig. 1.—Worker ant with bent abdomen.

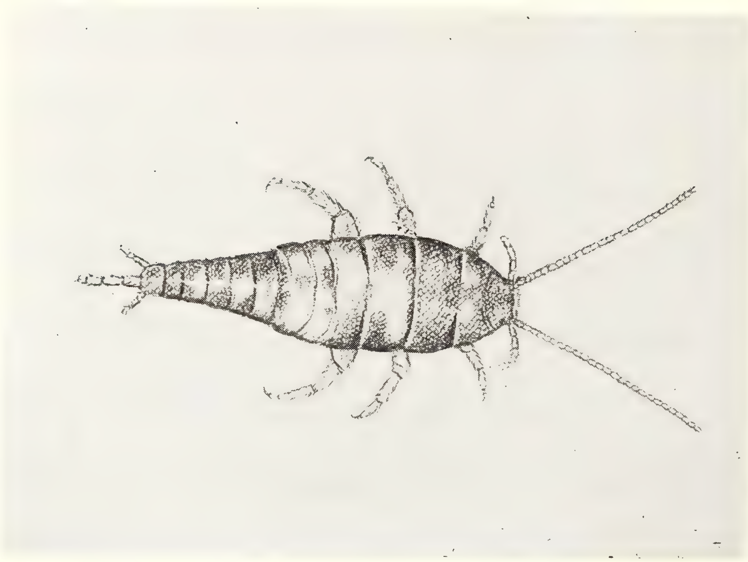


Fig. 2.—*Lepisma subnigrina cotygii* in nest of *Crematogaster d. artifex.*

dropped the particles over the edge, then cleaning its antennae and mandibles each ant went back to the pile for more. They kept steadily at their labour till the pile of food was cleared and every particle of it dropped over the edge. The legion of workers below were not idle. They picked up the particles as they were dropped by the workers above and carried them in a continuous stream to the nest.

The partiality of this species for honey and syrup or sugary liquid has already been commented upon. An ounce or two of jaggery syrup or honey solution kept inside their cages was consumed in the short space of an hour. In the act of feeding they presented a beautiful sight, arranging themselves in a regular row round the brim of the shallow vessel, drinking with their mouth parts dipped into the liquid. When satiated they remained motionless and inactive. In addition, these ants like some other species imbibe 'honeydew' from various Aphids and Coccids. This pastoral habit of 'milking' different kinds of Homoptera for the supply of 'honeydew' is not as strongly developed in these as in some other ants. But when available the syrupy fluid given out by these insects is eagerly sought after, as was observed when the ants' nests were placed on trees infested with coccids or when the ants were supplied with leaves or twigs covered with these minute insects. In rapid movement particularly when excited or alarmed the workers hold the abdomen curved over the back (Pl. IV, fig. 1). It is a trait characteristic of the genus, though a closely allied species, *C. rothmeyi*, the commonest of the fraternity in South India seldom displays this peculiar gait. The action of holding the mobile gaster bent over the back is probably a defensive device—in this position the sting is held like a lance in rest ready for action—it is a warning of prompt attack. When disturbed, the workers swarm out of the nests in thousands and their movements *en masse* produce a characteristic rustling sound like the patter of light rain on dead leaves.

Their relations among themselves and with others of alien colonies.—The workers of the same colony do not show any great tendency to team work and co-operation except perhaps in the process of nesting and occasionally in the face of a common enemy when they seem to act together. In the course of their normal activities they often meet one another in their marches and have been observed to exchange greetings by antennal wavings and strokes. Sometimes two individuals will stand with their mouth parts interlocked for about half a minute to exchange food. One noticeable feature is their occasional behaviour towards the frail, helpless winged males. These latter were often dragged, pulled out, mangled and thrown out from the nests.

Hostility among workers of different nests.—Great antagonism is exhibited by workers of different nests. About half a dozen nests were kept under observation in the laboratory at a distance of two to three feet from one another. Not infrequently batches of workers escaped from cages through holes bitten through the thick cloth covering. They marched on the table in groups and naturally encountered similar battalions from neighbouring nests. On such occasions great battles ensued between the parties and clusters of struggling ants interlocked in mutual assault and piles of dead were seen between the cages on the table. The workers do not of course possess any striking odour, but what little odour they emitted was certainly disagreeable.

Battle with black ants.—In order to find out whether it would be possible to establish these ants on trees in the plains as also to study their habits outdoors a few nests obtained from the hills were kept under observation attached to branches of suitable trees on the college premises. One such was grafted on to a branch of a *Peltophorum* tree and another to a *Neem* tree. Within a few hours after introduction the ants began to stream out along branches in small numbers. In the cool of the morning or evening particularly, large swarms of workers sallied forth in continuous streams along different branches and, as the sun grew hotter, returned with spoils of diverse kinds to the nest. Except during the hottest part of the day they were busy with their normal duties such as foraging, milking ant cattle, etc. But soon they were faced with a formidable enemy in the shape of the common black ant (*Camponotus compressus*). The soldiers and workers of the giant ants began to attack them all along their routes and attempted to storm their fortress after their retreat into the nests. The black ants possess the advantage of bodily size and strength and a more powerful armature of mandibles; but they were more cumbrous and certainly less agile in movement. Any unwary crematogaster caught between the great mandibles of a black ant was immediately killed. The smaller ants valiantly defended their nests against the intruding enemy; but despite the courageous defence they put up theirs was a losing fight. They were no match for the giants in single hand to hand fighting. But they soon developed different tactics and attacked their antagonists by rushing out of the nest biting a leg or antenna and immediately retreating into the nest. As many as twenty or thirty ants would engage in this hit and run battle against one of the giants, who knew not how to defend himself. Thus by their agility and the weight of their numbers they were able to stem the attack. Thus they defended their nests for days. The battle field round the nest and branches and on the ground below was strewn with many dead and dying black ants literally covered with numerous dead and dying crematogasters firmly clinging to legs, antennae and other parts. The colonies continued to flourish for about a fortnight. They were apparently not much affected by the weather. The nests withstood some heavy April showers except that the outer portions were slightly softened. But the colonies soon dwindled, probably on account of climatic changes, but chiefly as the result of an increase in the number of the black ants—too strong an adversary for these small ants to resist indefinitely. Ultimately one of the colonies was wiped out, and the other removed to the laboratory for observation.

Provisions in the Colony.—These ants do not keep any store of provisions in the nest. They appear to depend upon their daily labour for sustenance. Large quantities of the remains of termites and other used up food, mutilated wings, empty head capsules are sometimes found in the superficial compartments of their abodes. These are regularly cleared by workers from the nests. These ants have not been observed to keep any 'ant cattle' inside their habitations.

Guests in the Colony.—In almost all nests a good number of small dark-coloured Lepismids (Pl. IV, fig. 2) were commonly found. No other living creatures were noted associated with or living inside these curious nests. These small Lepismids were never seen in close communion with their hosts. They were observed gliding furtively through the galleries of the nests. The nature of their food or their precise relationship with their hosts have not been ascertained. The Lepismid is a dark insect with a broad thorax and tapering abdomen. *Size.*—Length 4.0 mm.; width at thorax 1.3 mm. They are very agile in their movements and highly elusive and therefore escape being caught. The specimens probably obtain their food from small droplets of sweetish liquids spilt during exchange of food by the ants. In their general appearance they have a close resemblance to the Lepisimid Atelura (Lepismina) recorded by Janet. The specimens have been identified by Dr. Silvestri as *Lepisma subnigrina* Silv. *cotygii.*[1] Are they Myrmecocleptics?

Census of the Community

The strength of the ant colony must greatly vary according to the supply of food. The colonies examined were invariably very populous. In order to obtain an idea of the population of a nest and to discover also the ratio of different castes, a nest from the branch of a tree was removed intact and enclosed with all its occupants in a long-cloth bag. The nest in question was a comparatively small one 7½ in. by 5½ in. in size. The entire nest in the bag was put in a closed glass jar and chloroform introduced. After a time it was found that the occupants of the innermost recesses were not killed. The nest was now cut up by a fine saw into four slices and its occupants were again chloroformed. The contents of the nest were later on emptied carefully and weighed and the numbers of individuals in sample weights were actually counted and the results are presented as below:—

Worker major including callows	39,082
Worker minor including callows	13,192
Males winged	4,614
Females winged	59
Female pupae	816
Female larvae large size	634
Eggs	37
Smallest larvae probably of ☿ and ♂	2,744
Pupae of ☿ and ♂	1,100

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[1] My thanks are due to Dr. Silvestri for the identification of the specimen.

CONCLUSION.

In the foregoing paragraphs an attempt has been made to present the life-economy, structure, life-history, relations, nesting architecture etc., of these wonderful ants. Their natural history on the whole constitutes one of the most fascinating and instructive chapters particularly in respect of animal instinct and ingenuity.

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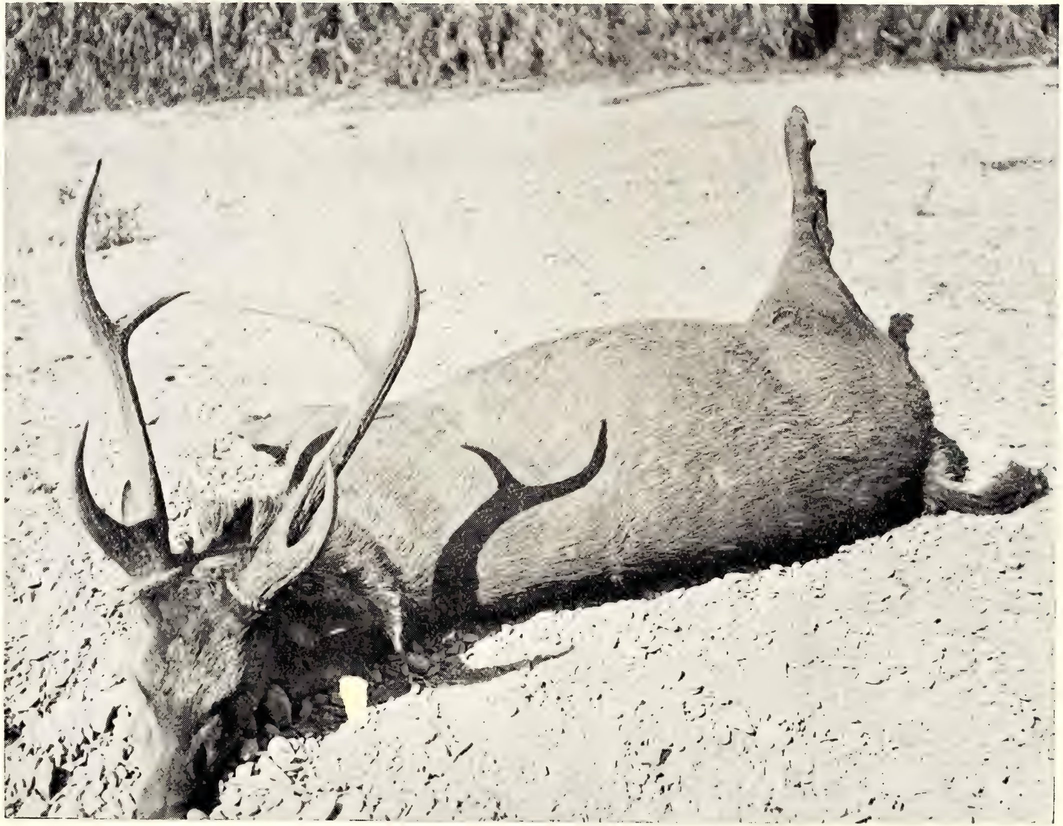


Malayan Sambar (*Rusa unicolor equinus*).

Photo by author.

THE MALAYAN OR BURMESE SAMBAR (*RUSA UNICOLOR EQUINUS*).

BY

W. S. THOM.

(*With a plate*).

The Sambar is described as the typical forest deer of South-Eastern Asia. Various races of this animal have been recognised within the wide area of its distribution. The typical form, the Indian Sambar (*Rusa unicolor unicolor*), ranges through India and Ceylon. It is the largest of all sambar and carries the finest horns. The Malay race, *Rusa unicolor equinus*, inhabits Assam, Burma and the Malay countries.

A Malay stag averages about 5 ft. in height, while a full-grown male weighs about 500 lbs. The horns of a mature Malayan sambar are set closer as a rule and average about 30 in. in length, but any horn over 35 in. is good. While the horns of the Malayan sambar are shorter than those of the Indian animal, they are massive and have a good if not greater average girth. The brow tine is usually much longer in proportion to the beam than is the case with the horns of Indian sambar. A heavy pair of antlers reaching 35-38 in. in length is a trophy worth having. The largest Malayan stag shot by me had a head of the following dimensions:—Length 42½ in., girth 9½ in., tip to tip 30 in.; widest inside 31 in., points 3 in. + 3 in. The head judging from the measurements given in the *Burma Game Manual* of the year 1929 is the record head for Burma. For India, the record is, I believe, the famous head from Bhopal which tapes 50⅞ in. So far as Burma is concerned, the best heads of deer, especially samabar, and of Bovines in general are to be found wherever there is a plentiful supply of food and water throughout the year and numerous salt-licks rich in bone and horn forming properties, together with a luxuriant growth of good grazing grass, undergrowth, evergreen tree and bamboo forest. Good feeding and horn and bone forming mineral salts seem to me to be material essential to the development of good heads. I am aware of course that in the dry zones of both India and Burma, where the pasturage cannot compare with what obtains in other parts of these countries, excellent heads are developed. But perhaps in these dry areas the absence of good grazing is compensated for by the presence of salt-licks rich in substance conducive to the growth of bone. My explanation may not be correct but I put it forward as a theory which may explain the prevalence of good heads in particular areas of the Sambar's distribution.

The average colour of the Malay Sambar is darker than the Indian species, approaching to black or slaty grey in old stags.

The hair is coarse and long and forms a heavy ruff round the throat in mature stags.

Sambar are found pretty nearly all over Burma wherever there is sufficient cover for them. I have come upon them in every type of country, and at all elevations in both heavy or open bamboo and tree forest, in *khaing* or elephant grass, in thickets of wild plantain and evergreen *ponzoes* or deserted cultivation. Sambar are however never found in the open scrub jungle, usually frequented by Thamin i.e. Brow Antlered Deer (*R. thamin*).

Sambar are rarely found together in any numbers. Stags and hinds are often found singly, but small herds of from six to a dozen in number are commonly met with.

Sambar feed mainly at night and, as such, are described as nocturnal animals, but hinds and young stags come out to feed with systematic regularity in the late afternoons and do not usually seek cover till the sun is well up in the morning. Old stags are more seclusive in habit. They often occupy very inaccessible places during the day and lie up on the tops of precipitous rocky slopes, where a good breeze is available to keep off the flies. Or, they resort to well-wooded plateaus at the head of steep rocky streams, from whence they are able to command a good view of the surrounding country. A sambar makes hardly any movement and no sound when resting on the ground. The occasional flicker of an ear or a slight movement of the withers betray his presence only to the trained practised eye.

Sambar love wallowing in mud wallows, especially during the cold weather and frequently resort to dew ponds, pools and the beds of drying streams, or they frequent wallows excavated by pigs, elephants and rhinoceros. They also visit salt-licks at night. A habit to which they are more addicted, in my opinion, than any of the other large or smaller game in Burma.

The question as to how often sambar drink depends a good deal on season, temperature, climate and on the amount of water available in the area. An important factor is the extent to which the animals have been subject to harassment. According to some of my Burma hunters, sambar drink nightly, others incline to the belief that they drink only every second or third night. I believe that these animals can go without water for even longer periods if obliged to, but if undisturbed, they drink regularly. Thamin, on the other hand, though living in hot dry regions, are very abstemious as compared with other deer and do without water for long periods.

Sambar are perhaps the most alert of all animals found in the jungles of Burma, with the exception perhaps of the Tapir. Like other animals they seem to have a sixth sense. At the slightest sign of danger, a sambar is able, in the darkest night, to dash through the jungle, carrying his spreading antlers through the tangle of trees and covering the most dangerous and precipitous ground in its headlong stride.

Compared with bison or tsaing, the sambar lives in closer association with Man. Its most deadly enemy in the jungle is undoubtedly the Wild Dog. My experience with these vermin is that the victim is hamstrung and not emasculated as is generally supposed. I once had the unusual experience of coming upon a huge emasculated boar, covered with wounds, limping painfully along, surrounded by about 20 wild dogs. None of the dogs showed any signs of injury. I succeeded in shooting two of them with charges of buck shot and put an end to the misery of the boar who, champing her jaws to the last, made a gallant effort to get at me. I have heard sambar scream on several occasions at night when seized by wild dogs. A pack of wild dogs will take mouthfuls out of a sambar whilst the animal is alive. I have heard the same agonising cry of fear from a wounded sambar seized to have its throat cut or *halalled.* It is a heart-rending sound impelled by overwhelming fear. Fear, occasioned by the imminence of death, must be potent in its effect on such highly strung and sensitive animals as deer. I have seen two instances of very young sambar fawns dying from fright. In both instances my hunters captured fawns that had run into our party instead of bolting with their dams. There were no injuries of any description on either occasion, for I made a careful postmortem examination and, although I had no means of diagnosing the cause of their death, I could only assume that, as neither of the animals had been roughly treated, they had died of heart failure, induced by fright. In one case the animal died in my hunter's arms within a few feet of me after a very brief struggle.

The sambar's customary 'bell' is a familiar sound in the Indian jungle. Peacock in his *Game Book for Burma* says he has not heard in Burma the loud belling notes made by sambar stags when disturbed. It seems to me that he has been somewhat unfortunate in this respect, as I have often heard them bell loudly in various parts of Burma. A stag sambar in full horn will invariably utter these loud belling notes of alarm on scenting a tiger or when disturbed or when suspicious of some noise it has heard in the jungle and cannot fathom. Any sound out of the common —like the fall of a heavy branch from a tree will cause sambar to bell repeatedly. A sambar taken by surprise gallops off with a succession of leaps and bounds for some distance and then, as often as not, pulls up suddenly and turning round to face the danger makes the welkin ring with its 'belling', while it also stamps its feet from time to time. Which brings me to the subject of 'stamping grounds'.

Sambar have regular 'stamping grounds'. In open grounds as well as in the jungle, one often comes across these circular bare patches, devoid of all vegetation which have been stamped bare by the hooves of sambar. These stamping grounds may be anything from 10 to 40 feet in diameter. The smaller grounds I suspect, are the work of solitary stags. Do these stamping grounds serve any particular purpose? Why do sambar make them?

Fletcher in his book *Sport in the Nilgiris* states that he could never account for these clear circular spaces made by sambar always under an overhanging tree. He did not credit the explanation given by the local shikaris that they were 'swinging places' and that a stag hooked his fore legs over the overhanging branch and swung backwards and forwards, his hind legs trailing on the ground kicking the space clear. A stamping ground is not necessarily made under overhanging trees. The sambar being essentially a forest animal, it is natural that the majority of these 'clearings' are found under trees. But I have found such stamping grounds right out in the open where there were no trees or bushes in their immediate vicinity. 'Josh', Fletcher's tame sambar solved the riddle as to how these stamping grounds were made. Fletcher discovered one of these open patches under a tree close to his bungalow and, feeling sure it was 'Josh's' work, he watched him. A few mornings later he saw 'Josh' go to the tree and indulge in the most extraordinary antics. He pawed up the ground turning slowly round and round at the same time, and then stood straight upon his hind legs like a goat. This was repeated over and over again. Many a morning and evening afterwards, Fletcher saw 'Josh' going through the same gymnastics, but the animal's reason for doing so were not clear to him. He suggests that his sambar was working of a redundancy of animal spirits. All wild animals are blessed with an excess of vigour and spirits which takes expression in curious ways. Village cattle and wild cattle, for no apparent reason, will suddenly begin digging up the ground or a mound of earth with their hooves and horns. It may be, as Fletcher suggests, that these antics are an outlet for surplus energy, but why sambar select and adhere to a special site for their performances is a puzzle. It is well known that many animals have the habit of resorting to a particular spot for dropping their excreta. It is suggested that in social animals this habit may serve as a guide in keeping individuals of a herd together. The stamping grounds of sambar may serve a similar purpose and provide a sort of meeting ground, particularly during the mating season. Fletcher unfortunately does not mention the age of his tame sambar, nor tell us whether it was a stag or doe, or the time of the year when the animal carried out its antics. It is signficant that these stamping grounds are never seen in the rains, but are most in evidence in the beginning and through the cold weather, which coincides with the main breeding season of sambar. At this period, the majority of stags are in rut; they commence to challenge each other. Such a stag might well give vent to its feelings in rearing up and stamping. Its antics would then result in making one of these 'clearings' or 'stamping grounds' which may thus become a meeting ground for combats and a place for continuous resort. I once had the good fortune to witness a fight between a couple of stags, surrounded by about 8 or 10 does and immature males in one of these 'clearings'. The particular stamping ground was right out in the open or the top of a watershed in the Yomah hills, at an elevation of about 4,200 ft. There was no jungle anywhere within 200 yards of the scene and I came upon the animals in broad daylight—an unusual circumstance, as from my observation their meetings seem to occur more often on bright moonlight nights. Two stags of the herd were engaged pounding away at each other with their horns and hooves, frequently standing up on their hind leg as goats do when they fight. The clash of their horns as they met in mid air could be heard some way off. The stamping ground on which this encounter took place had a diameter of 30 ft.

During the pairing season old stags stalk about with erected tail, outstretched muzzle and everted face glands and are then by no means pleasant-looking animals. At this time, in captivity at any rate, they are highly dangerous. The period of gestation, as I have observed it in Burma, is about 8 months. Most of the fawns being dropped during the monsoon at the end of June or about the beginning of July. But to this rule there are exceptions for I have several times seen a hind with a newly born fawn at heel in the early spring in Burma.

As to the season of horn shedding, sambar are said by most sportsmen to shed their antlers annually from about May to July and to be in hard horn again in December. In Central and Southern India, the majority of stags are said to cast their horns between the end of March and mid-April. The horns commence to grow in May and are in velvet during the rains. Dunbar Brander, writing of sambar in his *Wild Animals of Central India*, says that he had never heard of sambar being in full horn in August or September. R. C. Morris records shooting a stag in full horn in September in the Billigrirangan Hills, S. India and Mr. H. G. M. Dunn, in the first week of September, shot a fine stag which had certainly been in full horn during the latter part of August. My record sambar head for Burma, referred to previously, was shot about the 20th of September. Fletcher in his *Sport in the Nilgiris* says that he has shot stags in perfect hard horn in July and August, when they ought to have been carrying undeveloped heads; whilst he once bagged a stag in velvet in December. Forsyth agrees that sambar do not shed their antlers annually. There appears to be then much variation both as to the pairing season in sambar and the time at which the antlers are shed. Both are perhaps interconnected since the ability of the stag to fight and gain possession of a harem of females would depend upon the conditions of his horns. Variation in the time at which horns are fully developed would imply variation in the seasons of breeding and a parallel variation in the time at which females are ready to breed. This annual shedding of the horns by deer is a remarkable phenomenon and it has often puzzled me why Nature should, in the case of the deer tribe alone, build up a huge bony structure only to destroy her handiwork every year and begin the whole process *de novo*.

Another matter which has been the subject of comment is the frequent prevalence on the throat of a peculiar bare and hairless patch, about 6 in. in diameter, usually referred to as 'Sore Neck in Sambar'. I will not go so far as to say that every wild sambar in Burma has this sore, because I, and other people whom I could name, have come across several animals without it. I have even been told that a similar sore has often been seen on the necks of thamin or brow-antlered deer (*Rucervus thamin*) and observed, in one instance at least, on the neck of a barking deer. Even sambar fawns are occasionally affected. Sambar bred in captivity, both does and stags, are however free from such disfigurement. Peacock in his book states that the animals are free from these sores in India, but this is not the case at all. Several writers in India have commented on it. The cause, according to some writers, is said to be due to the attack of some parasite, but, so far as is known, this parasite has not been satisfactorily isolated or identified. A note on the subject appeared in the *Journal* of the Natural History Society of Siam under the signature of Mr. P. R. Kemp, who was engaged on survey work. Mr. Kemp shot several sambar in Siam and during the months of December and June he observed that they were all affected by a peculiar sore situated in the middle line of the throat. The actual sore was about 1½ inches in diameter and the skin around it was devoid of hair which had apparently been rubbed off over an area about 8 inches long by 6 inches wide. The sore was superficial and did not extend deeply. Mr. Kemp states that this disease is recognized among the Siamese as the *Khi-Ruon-Kwang* or the leprosy of the sambar. It is believed to be due to the animals eating the fruit of the *Ma-Kawk* tree, a kind of wild plum generally known as the 'wild olive'. Mr. Kemp unfortunately does not give the botanical name of this wild 'plum' or 'olive'. The appearance of the sore in these animals is stated by the Siamese to synchronise with the time of the appearance of fruit on the *Ma-Kawk* trees. To take Mr. Kemp's theory, so far as my experience goes the only 'wild plums or olives', if one can call them such, which both sambar and barking deer eat in this country are the 'Gwethee' (*Spondias mangifera*) and the 'Zibyuthee' (*Phyllanthus emblica*). The people of this country eat a cultivated and larger variety of *Spondias mangifera* which is quite palatable. I have seen as many as 12 or 13 bleached stones of the latter fruit lying on the ground where sambar have rested, bringing up the stones from time to time and leaving them on the ground. If I have correctly identified the 'olive' or 'plum', referred to by Mr. Kemp as causing the disease among sambar in Siam, would not barking deer which also eat both these fruit develop the same disease?

The same disease has been observed by members of the Bombay Natural History Society in Assam and, it would be interesting to know if this has been the case in other parts of India. Mr. Dunbar Brander (see pp. 937 and 938 of vol. xxvii, No. 4 of 31-7-21 of the *Journal of the Bombay Natural History Society*) says, 'I was much interested in the notes regarding the mark or disease observed on the throats of sambar. I have several times observed the same thing on sambar in the United Provinces, always during the period that hair and horn were undergoing a change. At this period sambar do not come under much observation and I am inclined to think the wound is more common than is generally thought. The sore has always emanated from the centre of a whorl of hair on the throat and, as it has only been observed by me during the time the animal was changing coat or horn, I naturally connected the two and came to the conclusion that the sore or mark was the result of the changes taking place. I can only throw this out as a suggestion.'

I wrote to the officiating Director of Veterinary Services, Burma, Rangoon, Captain S. R. Rippon, in June 1935, about this subject and asked him to kindly go into the matter if possible and see whether he could not ascertain why these sores on sambar existed. He informed me that the Director Mr. Mitchell was then away on leave and that he would go into the question on his return in October 1935, as he, personally, had no opportunities of shooting any sambar. I have since heard from Mr. Mustill, Game Warden, Burma, that Mr. Mitchell has supplied him with some test tubes containing preservative and that he, Mr. Mustill, was going to collect some of the exudation from the sore of the next sambar he shoots so that Mr. Mitchell may be in a position to make an attempt to diagnose the disease, if disease it is. The wound always emanates from the centre of a whorl of hair on the throat, as stated by Mr. Dunbar Brander, but it should be indicated that there is, normally, very little hair on the portion of the throat where the sore appears. If the sore or circular patch on the sambar's neck is not the result of a parasite or a secretory gland such as is found on elephants, camels, black buck, etc., then it may be the result of bites by ticks and the intense irritation set up by the animals pushing their way through *khaing* or elephant grass, 'theke', and under growth. The sore is finally enlarged by the animals rubbing their necks for relief against every tree trunk and branch they come across, the enlargement of the wound causing more ticks to be finally attracted to the spot. It should not be forgotten also that there are several plants that cause the skin to itch like the devil, as for instance, a climber with yellowish coloured hairy beans or pods and besides at least two kinds of stinging nettles, not to speak of a horribly itchy plant with largish leaves known in Burma as the *petya*. Then again there are the fine hairs of the bamboo which also set up an irritation when brought in contact with the skin. It is many years since I shot a sambar, but so far as my memory serves me, these wounds or sores on the necks of sambar, which I first noticed in 1890, although red in appearance, hardly bleed at all and only exude a kind of whitish-looking oily or watery substance. When sambar push their way through grass and tick-infested jungle, especially during the cold weather, when ticks seem to be more plentiful than at any other time, the animals hold their heads well up and these insects then find the throat and neck the most convenient spot on which to gather. Could this be the cause of the sore? Captain Rippon in his letter to me says that the skin on the bare patch on the tame sambar's neck in the Rangoon Zoological Gardens appears to be quite normal, i.e. there were no signs of any parasitic disease to the naked eye nor does it appear as if the hair has been lost by rubbing. Captain Rippon also thinks that the bare patch is probably a normal characteristic of the species and he doubts whether the sores are due to rubbing. He states also that it certainly would seem to be too much of a coincidence to find only this area on the neck affected in that way in every case, ticks must be found on other parts of the body as well where the skin is protected by a full growth of hair which at the same time is capable of being rubbed by the animal at will. Captain Rippon in his letter to me also goes on to say that Dunbar Brander's theory would appear to suggest that the sore may be connected with rutting. This, he says, is interesting as the sore might be some secretory gland which functions only at times of sexual activity, but is there, he remarks, any evidence that the sores are seen only in the cold weather i.e. during the mating season? Major C. P. Evans in his book *Big Game Shooting in Upper Burma* has a lot to say on the subject of the sambar sore, *vide* pp. 144-8 of his book, but I will only quote a few extracts. He says that the Burman and Indian Shikaris state that the sambar is attacked by a parasite (I doubt whether they could explain what a parasite was) and that the sore is caused by the animal rubbing itself to get relief from the irritation. This he says no doubt is true so far as it goes; but they are quite unable to explain why sambar should invariably be attacked in exactly the same place, or why the sore should be as circular as if it were made by a pair of compasses, and why sambar alone of all deer should be so afflicted. But are sambar the only deer so afflicted? Haven't black buck in India got it? Evans goes on to say that he does not himself believe in the rubbing theory. If the beast rubbed itself against a tree or branch to get rid of the irritation it would do so with an up and down motion and the result would be irregular scratches along the throat. But strange to say in spite of the forbidding appearance of the sore sambar do not appear to be at all inconvenienced by it. Evans says that he has watched sambar, when out in the open both in India and Burma for half an hour or more at a time, on purpose to see whether the animals rubbed the sore; but he never saw any sambar whether young or old pay the slightest attention to it. That the disfigurement is caused by a peculiar parasite which only attacks the sambar is according to Evans quite certain; but why it should invariably confine its attentions to the throat, or why it should cause a complete circular sore and having done so, desist from further attack he is unable to explain. Judging by the bleeding spot in the centre of the circle it looks, according to Evans, as if the parasite having reached its limits, returned to the original spot and fed there, since it is, in full grown animals always quite raw, the remainder of the circle being merely bare and pink-looking. Seen in the early dawn this raw spot has quite a gruesome appearance.

Colonel C. H. Stockley also comments on the 'sambar sore' or 'sore neck' on page 153 of his book *Big Game Shooting in the Indian Empire*, but he adds nothing new except to say that he has shot sambar without the sore as well as with the sore. However let us hope we will have a complete or at least a partial solution of the mystery after Mr. Mitchell has examined the contents of the test tubes which will no doubt be forwarded to him by Mr. Mustill in due course.

The hunters in the Ruby Mines District of Upper Burma have stories about a small active little animal they call a *Sat Kalauk* which, although perhaps larger than a weasel, is said to be not unlike that animal in appearance. This creature is said to spring at and hang on to the throats of sambar as they move through the jungle. It appears they seize the sambar by the throat with their teeth and, after hanging on for a few seconds and drawing blood, drop off again. I wrote to Mr. Mustill, Game Warden, Burma about this matter and asked him whether he could make enquiries to get to the bottom of the matter. He promised to do so. *Sat Kalauk* in Burmese means the sambar's bell, *sat* meaning sambar, and *kalauk* a bell, or wooden neck knocker, or clapper. These bells are worn round the necks of elephants and buffaloes when they are loosed in the jungle so that their owners may know where the animals are as the clapping sounds of these bells can be heard quite a long way off. Why this ferocious little animal the *Sat Kalauk* should want to attack such large animals as sambar is a mystery. I see Mr. Peacock on page 274, of his book *A Game Book for Burma* etc. refers to the Indian Marten (*Charionia flavigula*) Burmese *Nabashing* as being the *Sat Kalauk.* He also says that many jungle Burmans insist that Martens occasionally run down and kill barking deer. There is no doubt about this. It is a very destructive animal and is often caught killing fowls, seizing the birds by the throat. As a matter of fact, there is a general belief in the Ruby Mines District, that the *Sat Kalauk* will kill and feed on the body of any animal it can pull down and all seizures by it are evidently made at the throat. Mr. Ryan of the Ruby Mines shot one of two pine martens that had killed a village goat and were eating it when he appeared on the scene and shot one of them. The death wound on the goat in this case was also on the throat. The pine marten is also very destructive to fruit and Indian corn gardens.

The most commonly seen game track in Burma is that of the sambar, yet, as Mr. Peacock truly remarks, one may hunt for days without seeing a single specimen. Stalking sambar on foot is by far the most sportsmanlike way of killing them, but I am afraid more are shot now-a-days from cars and in beats, or drives, or by hunters at night on foot equipped with electric torches, than by the legitimate means of stalking. The eyes of the animals are plainly seen at night when a torch is used and many a sambar has been done to death at night by this means and has had a charge of buck shot fired into its body at random only to get away to die, sometimes days afterwards, a miserable lingering death. Sambar are difficult animals to drive, marvels at finding a weak spot in a beat and most determined in breaking back. It is perfectly marvellous, as *Rohilla* says, with what complete silence so heavy a beast with his spreading head will make his way in front of the line through dense cover and over broken rocks. The sportsman may have sat for an hour with exemplary patience, silent, motionless and noiseless, at his post. A big sambar may have come up close without the 'gun' having had the faintest inkling of it, and may have been standing suspiciously sniffing the air, and listening with its huge ears, making up its mind for a further advance, should the beaters approach too near. Should the sportsman under such circumstances, seeing the beaters close up and imagining that all is over, move even an eyelid, the wary beast is off with a plunge and a crash, either back through the line of beaters, or down hill to turn their flank, sometimes giving the occupants of the less sought for posts below a chance of a shot. Another moment or two of motionless silence and the occupant of the post would have had an easy shot at the huge deer, as he walked delicately like Agag along the well known path, or quietly scrambled up the rocky defile to the top. All the other animals come along with much less concern or concealment; only the sambar stag is thus cautious.

It is certainly much grander sport following and stalking the sambar on foot. The ground may be difficult, steep, dangerous and rocky; but where a deer can climb a man can climb also. The jungle may be dense, and the foliage luxuriant, but the sportsman content to wander all day in the forest rifle in hand for the chance of obtaining a shot accompanied by only one or two men is sure to meet with ultimate success although he will probably not bring to bay so many animals as the man who lurks behind a tree or rock, and has the game driven up to him to be murdered at point blank range, or as the man, who dazzles the vision of an animal at night with the headlights of his car and then slaughters it in cold blood at five or ten yards range.

I have already referred to the large sambar stag shot by me the measurements of whose antlers I have given. I came upon this animal suddenly at about fifteen paces in more or less open country, when turning a bend of a stream in the Thayetmyo Yoma hills, where the rushing sound of the water drowned the foot-steps of myself and hunters. Two soft-nosed bullets from a double hammerless 303 Enfield Rifle accounted for him. The first bullet got him in the neck paralyzing him, whilst the second shot went through his heart and brought him down with a crash. Although a stag sambar does not appear to possess the vitality of some animals of lesser size that I have shot, I am of opinion that the 303 is not powerful enough for these large deer. A ·400, ·423, ·318 or even a ·375 would be more effective. Some people have of course shot them at close quarters in a drive using a 12 bore shot gun and lethal ball or even with L.G. or S.G. buck shot.

Sambar are, or were, until quite recently hunted on foot with dogs by sportsmen armed only with long hunting knives. The animal, which is not a great stayer at any time in any country, and seems also to succumb more easily to a rifle bullet than most animals, is easily run down and bayed by the dogs, when the sportsman steps in with his knife and administers the *coup de grâce*. It is a highly exhilarating but dangerous sport as I have experienced myself in Ceylon. A sambar stag can inflict a dangerous wound with his horns, whilst the hunter has also to be in the pink of condition to stay the pace. These animals can also rear up and strike out with their fore feet besides using their horns to gore one. Sambar when exhausted and run down by dogs or by human agency take, as often as not, to the nearest stream, and stand at bay in the deepest pool they can find until the end comes. It seems a pitiful end for such a grand beast. They take to water readily and swim with the body submerged, only the face and the antlers showing above the surface.

The skin of a sambar is useful if properly tanned and converted into leather for trunks, kit bags and foot wear. As a trophy the skin is useless because of the coarseness of the hair.

The horns, when in velvet, are much valued by the Chinese for medicinal purposes. Such horns when obtained are smoke-dried and sold for about Rs. 25 to Rs. 30 per pair. A Russian, at the present time, is doing a roaring trade in Korea by farming deer with the object of selling horns when in velvet to the Chinese.

THE ORNITHOLOGY OF TRAVANCORE AND COCHIN.

BY

SĀLIM ALI.

With Notes by HUGH WHISTLER.

PART VII.

(*Continued from page 35 of this volume*).

SUB-FAMILY: BUBONINÆ.

Ketupa zeylonensis leschenaulti (Temm.). The Bengal Brown Fish-Owl.

Specimen collected: 932 ♂ 3-12-33 Nemmāra 300 ft.

Elsewhere noted at: Thattakād (200 ft.).

Colours of bare parts: Iris golden yellow; bill pale greenish grey, dusky on culmen and tip; legs and feet dusky yellow; claws horny brown.

[The specimen (♂) measures:

Bill.	Wing.	Tail.	Tarsus.
50	379	190	71 mm.

No other Travancore specimens seen.—H. W.]

Occasional solitary birds were observed on rocks in the Periyār River at dusk. A pair at Nemmāra had their domicile among large trees in the compound of the Travellers' Bungalow. In this locality the species was noted as fairly common. Its call—a subdued eerie ventriloquistic *boom-boom* etc.—was heard chiefly at dusk. On the whole, the Brown Fish-Owl is perhaps commoner in our area than the Survey records suggest. According to Ferguson (*J.B.N.H.S.*, xv, 667) it is 'common in forest land in the low country [of Travancore] near the sea coast'. He mentions specimens that had lived in captivity in the Public Gardens, Trivandrum, for 10 years. Elwes (*Ibis*, 1870, p. 527) found this owl common in the lower valleys of the Cardamom Hills.

In the Palni Hills, both Fairbank and Terry (*S.F.*, v, 392 and x, 469) have recorded it from Kodaikānal. In Ceylon it is represented by the typical race which has a general distribution up to 4,000 ft.

Breeding: The testes of the specimen (3 December) measured 10×5 mm. Ferguson gives the breeding season in Travancore as March and April.

Bubo bubo bengalensis (Franklin). The Indian Great Horned-Owl.

Specimens collected: 628 ♂ 19-4-33, 633 ♀ 21-4-33 Arāmboli 250 ft.

Elsewhere noted at: Nemmāra (300 ft.).

Colours of bare parts: Iris bright reddish-orange; bill horny brown; feet greyish-brown; claws horny brown.

[These specimens extend the known range of this species. The ♂ measures:

Bill.	Wing.	Tail.
42	365	185 mm.

—H. W.]

The Indian Great Horned-Owl has not been previously recorded from Travancore or Cochin. It was, in fact, not known to occur in South India south of about Madras on the east and the Nilgiris on the west.

At Nemmāra (Cochin) only a single example was observed in open teak forest at the base of the Nelliampathy Hills, on the edge of the Pālghāt Gap. At Arāmboli (South Travancore), however, the birds were not uncommon. During the daytime they kept to fissures and hollows among the gigantic boulders on the hillocks flanking the Arāmboli Gap, whence they issued forth at dusk with deep resonant hollow calls of *Bu-bo* etc. At this hour they were usually seen perching on the summits of boulders etc. whence they presently glided off on outstretched wings for enormous distances—occasionally covering half a mile or more without a flap—to their accustomed feeding grounds in the cocoanut plantations and cultivated country about the town.

It has not been met with in the Palni Hills and it evidently does not occur in Ceylon.

Breeding: The gonads of the specimens (19 and 21 April) were inactive. No other data in this regard was procured by the Surveys.

Huhua nipalensis nipalensis (Hodgson). The Forest Eagle-Owl.

Not met with by the Surveys.

Ferguson (*J.B.N.H.S.*, xv, 667) states that this owl is not common in Travancore. Two specimens taken alive in the low country forest lived for some time in the Public Gardens at Trivandrum. Another was shot in the High Range.

It has not been recorded in the Palnis, but it occurs in the Ceylon hills.

Breeding: According to J. Stewart (*Fauna*, iv, 418) the breeding season in Travancore is December and January.

In dense mixed forest at Thattakād (200 ft.—February 1933) and also at Tenmalai (500 ft.—March 1933) after dark and frequently all through the night, was heard the long-drawn kite-like whistling call of an owl, the identity of which I was unable to establish. A specimen of this bird was shot while calling in December 1932 in the Biligirirangan Hills (Coimbatore District), but unfortunately lost in the scrub in the darkness. In the beam of the electric torch it looked about the size of a kite. Can it have been this Eagle Owl?

Otus bakkamoena bakkamoena Pennant. The Ceylon Collared Scops Owl.

Specimens collected: 459 ♀ juv. 16-3-33 Rājampāra 1,350 ft.; 933 ♀ 3-12-33 Nemmāra 300 ft.

Elsewhere noted at: Kōttayam; Chālakūdi.

Colours of bare parts: *Juvenile* (459): Iris yellow; bill pale horny brown; feet greenish-plumbeous; claws horny brown. *Adult* (933): Iris brown; bill horny brown, paler on lower mandible; mouth pink; legs and feet brownish flesh colour with a pale creamy tinge; claws pale horny brown.

[Additional specimens examined:

Brit. Mus. Coll.: ♀ 3-3-96 Zoo Gardens, Trivandrum (Nair); o? no date Trivandrum (Fry); ooo? no date Mynall (Bourdillon). Cf. *S.F.*, vii, 34.

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
2 ♀♀	21-22	144-147.5	68.5-69.5	27.5-30.5 mm.

The juvenile No. 459 of this species is remarkably different from the adult, but I have no doubt that it is correctly identified as a juvenile in my collection from Sikkim of the closely allied *O. b. lettia* exhibits very similar differences. The upper plumage is grey on the forehead, crown, sides of the head and nape, and browner on the mantle, back, rump, upper tail coverts and lesser wing coverts, the feathers finely stippled and vermiculated with dark sooty brown; wings and tail, including tertiaries and greater and primary coverts as in the adult (grey phase); chin whitish; remainder of lower plumage greyish-fulvous, the ruff somewhat brighter, all feathers faintly barred and stippled with sooty brown.—H. W.]

This little owl was fairly common in the localities named where it kept to well-wooded compounds in villages and towns, and also to deciduous forest. Its mellow but monotonous *wut?-wut?* note, repeated at intervals of 3 seconds or so, was usually heard at dusk and late into the night, and then again in the early mornings. It probably continues throughout the night.

Ferguson (*J.B.N.H.S.*, xv, 667) describes the Scops Owl as very common throughout the low country in Travancore, but says that it does not ascend the hills. Bourdillon (apud *Nidification,* iii, 516) says that it also occurs in the foothills of Travancore and up to 2,000 ft. elevation.

There is no record of this species in the Palni Hills. It is common and generally distributed in Ceylon, up to 3,000 ft.

Breeding: Specimen No. 459 (18 March) was a juvenile with a very soft skull. It appeared to be about a month old and was moulting out of down plumage.

Bourdillon (*Fauna*, iv, 424) found this owl laying its eggs in holes in buildings in Travancore, but elsewhere it is said to nest in natural holes in trees. The breeding season in Travancore is given as January and February (*Nidification,* iii, 516).

[**Otus sunia rufipennis** (Sharpe). The Indian Scops Owl.

Not met with by the Surveys. Mr. Whistler mentions (*J.B.N.H.S.*, xxxviii, 236) that in the British Museum there is a ♀ collected by R. H. Morgan in the Pālghāt Hills in April 1876, and three Anjango specimens without precise data. The species probably occurs in our area since the Pālghāt Hills are sufficiently close to the northern boundary of Cochin State to allow of the probability even if the Travancore evidence is ignored, knowing that the 'Anjango' specimens are often of uncertain and doubtful origin.]

Athene brama brama (Temminck). The Southern Spotted Owlet.

Specimens collected: 538 ♂ juv., 539 ♀ juv., 540 ♀ juv., 541 ♀ ad. 8-4-33, 565 ♀ juv., 566 ♂ juv. 11-4-33 Cape Comorin ca. S.L., 702 ♀ 21-7-33 (Beach), 856 o? (Golf Links, ca. 100 ft.) Trivandrum.

Elsewhere noted at: Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Trichūr; Ernākulam.

Colours of bare parts: *Juvenile*: Iris lemon yellow or greyish yellow; bill pale sea green; feet greenish grey; claws horny black. *Adult*: 'Iris yellow; bill plumbeous; mouth bluish pink; feet plumbeous; claws brownish black' (Pillai).

[No additional specimens with proper data seen.

Measurements:

	Bill.	Wing.	Tail.
1 ♂	21	158	71.5 mm.
2 ♀♀	21	156	68-71.5 mm.

The post-nuptial moult is complete and there is no spring moult. The post-juvenal moult does not appear to include the wings and tail.

Dr. C. B. Ticehurst reports on the down plumage of this owlet as follows: 'Pure white, short and very soft prepennae cover body, except apterions of lateral neck, lateral body in front and each side of spinal tract above. Some preplumulae of same type of down on lateral apteria in front.'—H. W.]

This species is without doubt the commonest owl in Travancore. In our experience and that of Ferguson (*J.B.N.H.S.,* xv, 668) it is confined to the low country, but *Nidification* (iii, 525) says that it is also found in the Travancore hills up to 1,000 or 1,500 ft. elevation.

The birds may be met with usually in the neighbourhood of villages and cultivation, and wherever there are topes of large trees—especially old mango, tamarind and the like—with hollow trunks and branches to furnish harbourage. Old buildings and crumbling walls also provide suitable dwelling and nesting sites. As in Ferguson's day, they freely continue to inhabit the old ruins of the fortified 'Travancore Lines' near Cape Comorin.

Sunlight does not seem to inconvenience this owlet greatly and it may frequently be seen on the move during the day when, however, it is mercilessly chivvied by other birds.

It has not been recorded from the Palni Hills and it does not occur in Ceylon.

Breeding: Four of the April specimens were juvenile in various stages of the down plumage. There is a marked discrepancy in the sizes of the young in a brood which suggests that incubation commences from the laying of the first egg. As the full clutch consists of 3 or 4 eggs there may often be a difference of as many days between the ages of the first and the last to hatch.

At Cape Comorin and Arāmboli, between 8 and 16 April, numerous nests were found in holes in crumbling walls and buildings or rotten tree trunks and branches. All these nests contained either hard set eggs or downy chicks. The nests emitted a strong and nasty stench. A number of family parties were also observed about at this period.

Ferguson gives the breeding season in Travancore as March and April.

Glaucidium radiatum malabaricum (Blyth). The Malabar Jungle Owlet.

Specimens collected: 33 ♂ 7-1-33 Marāiyūr at 4,500 ft.; 461 ♀ 18-3-33, 471 ♂ 19-3-33 Rājampāra 1,350 ft.; 781 ♀ 3-8-33 (Kōvalam ca. 70 ft.), 830 ♀ 11-8-33 (Pūlayanārkotta, near Veli Lake) Trivandrum Environs.

Elsewhere noted at: Kūriārkūtti (1,600 ft.—Annemalai Hills, Cochin).

Colours of bare parts: Iris bright lemon yellow; bill and feet dirty greenish-yellow; claws horny brown.

[Additional specimens seen:

Brit. Mus. Coll.: ♀ 12-3-78 Travancore (Bourdillon); ♂♂♀ no date Mynall (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
4 ♂♂	19.5-21.5	128-135	65-69	22 mm.
5 ♀♀	19.5-21	124.5-134	61.5-68	20-22 mm.—H. W.]

The Jungle Owlet is not uncommon in the deciduous forest tracts of Travancore and Cochin, chiefly in the low country and foothills but occasionally up to about 2,500 ft. One of the specimens was shot at 4,500 ft. elevation.

It was usually met with, singly or in pairs, in secondary open deciduous jungle, especially the bamboo facies. The bird gives itself away by fussily flying off from its perch on the approach of the observer, and seems little inconvenienced by bright sunlight. It settles on another branch or tree a short distance away, sitting upright and motionless but with head screwed round and staring hard at the intruder, looking all the time exactly like the stump of a dead branch.

There is no record of this owlet from the Palni Hills though it probably occurs in the deciduous country about their eastern base. *Glaucidium castanotum* found in a wet zone in Ceylon may possibly prove to be a race of this species. (See Eastern Ghats Survey, *J.B.N.H.S.*, xxxviii, 237.)

Breeding: Specimens Nos. 461 and 471 (18 and 19 March) were evidently preparing to breed shortly. Some of the ovarian follicles of the former were 1-1.5 mm. in diameter, while the testes of the male measured 6×4 mm. No other breeding data was procured by the Surveys.

According to Ferguson (*J.B.N.H.S.*, xv, 669) the Jungle Owlet breeds in Travancore in March.

Ninox scutulata hirsuta Temm. & Lang. The Southern Indian Hawk-Owl.

Not met with by the Surveys but I have seen a specimen in the Trivandrum Museum labelled o? 19-6-1893 Trivandrum, and another in the museum of the Maharaja's College, Ernākulam, obtained in that neighbourhood.

[Specimens seen:

Brit. Mus. Coll.: ♂ 26-11-79, ♂ 24-2-78, ♂ 3-12-74 Mynall (Bourdillon).
3 ♂♂ measure:

Bill.	Wing.	Tail.
22-23.5	197-198	114-116 mm.—H. W.]

Ferguson writes (*J.B.N.H.S.*, xv, 668) that the Hawk-Owl is not uncommon in the Travancore hills at about 2,000-2,500 ft. elevation, and that it also occurs in forest land in the low country.

The Surveys appear to have overlooked this species completely. Bourdillon (*S.F.*, iv, 373) says that it frequents heavy jungle and the borders of clearings where on moonlight nights during winter numbers may be heard calling to one another. He describes the call as a monotonous double hoot (the first syllable prolonged, the second cut short) uttered from the bough of some bare tree.

In Ceylon this Hawk-Owl is generally distributed up to 4,000 ft.

Breeding: January to May are said to be the breeding months in Travancore (Bourdillon, *Nidification,* iii, 536).

ORDER: ACCIPITRES.

FAMILY: PANDIONIDAE.

Pandion haliaëtus haliaëtus (Linn.). The Osprey.

Specimen not obtained.

Noted at: Cape Comorin.

Ferguson states (*J.B.N.H.S.*, xv, 668) that in Travancore the Osprey is a winter visitor to the lakes near the coast. Its status in Cochin is possibly the same although it cannot be anything like common since the Survey failed to come across it there altogether. In Travancore also it was not noted about the Vembanād Lake or in such other likely localities by the backwaters in February. Only a solitary bird was observed by Humayun Abdulali near an irrigation tank, a couple of miles inland from Cape Comorin, on 9 April by which time the hot weather emigration had presumably commenced.

FAMILY: ÆGYPIIDÆ.

Sarcogyps calvus (Scopoli). The Black, Pondicherry, or King Vulture.

Specimen not collected:

Noted at: Marāiyur (3500 ft.); Thattakād (200 ft.); Peermade (3,200 ft.); Kūmili (3,000 ft.); Chālakūdi; Pādagiri (3,000 ft.).

This species is perhaps the commonest vulture in Travancore and Cochin, and is generally distributed throughout the area. At Marāiyūr it was noted as practically the only vulture. While their numerical proportion to other vultures at wayside carcases of cattle remains more or less constant in the low country—namely the usual two or three birds to each gathering—on one occasion at Peermade (3,200 ft.) over 20 of these birds had collected at a carcase to the almost complete exclusion of the other species. At Pādagiri also an assemblage of about 30 Black Vultures were observed in company with others of their ilk at the viscera and some scrappy remains of a Nilgiri Tahr after the rest had been cut up and removed by the coolies. I have not seen such large concentrations of this vulture elsewhere.

In the Palni Hills, Fairbank (*S.F.*, v, 391) observed it rarely at the base of the hills, and Terry (*S.F.*, x, 468) more frequently at Pulungi. It is not found in Ceylon.

Breeding: There is no published record of its breeding in Travancore or Cochin.

Howard Campbell has found it breeding at Kodaikanal in the Palni Hills (*Nidification,* iv, 7).

[**Gyps fulvus fulvescens** Hume. The Indian Griffon Vulture.

Specimen not collected.

I include this vulture in my Travancore list with diffidence and with a full realisation of the fact that no authentic records apparently exist from further south in the peninsula than Dūmagūdiem on the Godāveri River. I must admit also that I often find it extremely difficult to differentiate between this vulture and *indicus* in the field and that under the circumstances the bare sight records can carry no real scientific value. However, as the note was made in the field with a proper realisation of these difficulties and under the two species separately, it might be as well to transcribe it for what it is worth, in the hope that a future collection of vultures may prove or disprove its correctness. The record I have is as follows: 'Kūmili 3,000 ft.—28 February.

Often suspected, but at least one definitely of this species seen in an assemblage at a carcase near the Travellers' Bungalow'.

Vultures have been consistently neglected by collectors due, as in the present case, to lack of storing accommodation which of necessity has to be restricted owing to the itinerant nature of survey work. These and the larger birds of prey generally constitute, on this account, the weakest section of most collections. Yet they are a most important group and our knowledge concerning them is in many cases surprisingly deficient. Their collection may be recommended to people who are more or less permanently stationed in various localities and who are not obsessed by immediate difficulties as regards the storage and transport of their material.]

Gyps indicus indicus (Scopoli). The Indian Long-billed Vulture.

Specimen not collected.

Noted as follows: 'Marāiyūr 3,500 ft.—13 January. 7 or 8 birds appeared suddenly at a carcase of a dog when not a single one was in evidence in this locality during the last 10 days.'

'Kūmili 3,000 ft.—28 February. Several at a carcase near Travellers' Bungalow.'

'Pādagiri 3,000 ft.—19 December. Over 15 birds of this species at remains of Nilgiri Tahr in steep valley, in association with *S. calvus* and Kites.'

The Long-billed Vulture is not common as vultures go, but generally distributed in small numbers in Travancore, and its status in Cochin is about the same. Ferguson (*J.B.N.H.S.*, xv, 668) considered it rare in the former area. He mentions a live specimen brought in from Nāgercoil, and that was the only locality he knew where it had been obtained in Travancore.

Fairbank and Terry both include it in their Palnis lists where, however, it does not seem to be common. It does not occur in Ceylon.

Breeding: There are no published records of its breeding in our area.

Pseudogyps bengalensis (Gmelin). The White-backed or Bengal Vulture.

Specimen not collected.

Noted at: Peermade (3,200 ft.); Kūmili (3,000 ft.); Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Pādagiri (3,000 ft.).

This species is perhaps the commonest vulture in Travancore and Cochin though by no means as abundant as it is, for instance, in the Deccan and in many other parts of the peninsula. Carcases, whether in the low country or on the hills, seldom elude these birds for long. In an assemblage of about 40 vultures at the remains of a Nilgiri Tahr shot in the Nelliampathies (ca. 3,500 ft.) only 2 or 3 individuals of this species were observed, however. On these hills, according to Kinloch (*J.B.N.H.S.*, xxvii, 943) the White-backed Vulture comes up as a temporary visitor from the plains and only roosts up there if gorged. This is probably true of the Travancore hills also.

Fairbank and Terry appear to have overlooked it in the Palni Hills.

Breeding: According to T. F. Bourdillon (*J.B.N.H.S.*, xv, 669) a colony of these vultures used to build regularly every year in a bit of forest adjoining Oliver's estate [?] in the Ashāmbū Hills in South Travancore. When the forest was cleared for coffee, the birds entirely deserted the place. He gives the breeding season in Travancore as February to April.

Neophron percnopterus ginginianus (Latham). The Smaller White Scavenger Vulture.

Specimen not collected.

Noted at: Nāgercoil; Cape Comorin; Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Nemmāra (300 ft.).

The Scavenger Vulture is not uncommon in the dry low country of South Travancore—and in similar facies also in Cochin—though nowhere abundant. It frequents the neighbourhood of towns and villages the population of which provide it directly or indirectly with sustenance.

Kinloch (*J.B.N.H.S.*, xxvii, 279) only observed a solitary bird by some coolie lines in the Nelliampathy Hills.

In the Palni Hills, on the other hand, Fairbank (*S.F.*, v, 392) and Terry (*S.F.*, x, 468) found this vulture on the slopes and occasionally on the tops of the hills up to 5,000 ft. Whether it is a resident on these hills or merely visits them temporarily from the plains in search of food—as is likely—is not stated.

It is a straggler into Ceylon.

Breeding: At Arāmboli (18 April) a nest was located on a ledge of an inaccessible rock-scarp which evidently contained young. One of the owners visited the nest with a beakful of food that through field glasses looked like ordure. No published records of its breeding in Travancore or Cochin are available.

FAMILY: FALCONIDÆ.

SUBFAMILY: FALCONINÆ.

Falco peregrinus calidus Latham. The Eastern Peregrine Falcon.

Specimen not obtained.

Noted (either this or the next species?) at: Kōttayam backwaters near Alleppey (18 February); Cape Comorin (10 April).

The Peregrine is evidently an uncommon winter visitor to Travancore and Cochin. The Survey definitely recognised it only once when a bird swooped down on a wounded Caspian Tern and attempted to carry it off.

Ferguson states (*J.B.N.H.S.*, xv, 672) that his collectors secured a single specimen on the backwaters in North Travancore in December 1903 and saw a second, also near the backwaters, at Quilon.

Falco peregrinus peregrinator Sundevall. The Shahin Falcon.

Not met with (?) by the Surveys.

Ferguson records (*J.B.N.H.S.*, xv, 673) a single specimen shot by a Mr. Walch in Trivandrum and sent to the Museum in November 1893.

Kinloch (*J.B.N.H.S.*, xxvii, 943) says the Peregrine is common on the Nelliampathy Hills and breeds on the precipices of the northern slopes. Mr. Whistler points out (*J.B.N.H.S.*, xxxviii, 418) that this is probably the race to which Kinloch refers.

[**Falco jugger** Gray. The Laggar Falcon.

I have a doubtful sight record for this species from the Ūrūmbikera Reserve Forest, near Mūndakāyam, ca. 1,000 ft. elevation—16 February. A solitary bird was being chivvied by *Astur badius*.

There are no published records of its occurrence in Travancore or Cochin, and apparently only 2 for the whole of the Madras Presidency (Whistler, *J.B.N.H.S.*, xxxviii, 419).]

Falco severus rufipedoides Hodgson. The Indian Hobby.

Specimen not obtained.

Noted at: Cape Comorin (ca. S.L.); Pādagiri (3,000 ft.)?

Mr. Whistler has seen the following specimens in the British Museum: ♂ no date Travancore (Bourdillon); ♂ 27-4-1874 Kowdiar, S. Travancore; ♂ 14-2-14 Aneichardi (Stewart).

The status of the Hobby in Travancore and Cochin is in some doubt. The Bourdillon brothers considered that it might breed in Travancore, but Ferguson says (*J.B.N.H.S.*, xv, 673) that it may be seen on the hills and occasionally in the low country in the cold season. He evidently believed it to be only a winter visitor to Travancore.

Kinloch (*J.B.N.H.S.*, xxvii, 943) found it not uncommon in the Nelliampathy Hills. As he does not specify any season, it is evident that he also believed it to be a resident.

Nidification (iv, 34) says: 'It certainly occurs and must breed in the Travancore hills.'

Falco tinnunculus tinnunculus Linn. The European Kestrel.

Specimen collected: 918 [♂ ad.] 29-11-36 Wadakkāncheri 400 ft.
Additional specimen seen by Mr. Whistler:
Brit. Mus. Coll.: ♂ imm. Travancore (Fry).

Falco tinnunculus objurgatus (Stuart Baker). The Indian Kestrel.

Specimens collected: 551 ♀ 9-4-33, 573 ♀ 12-4-33 Cape Comorin S.L.

Elsewhere noted (races undifferentiated): Maraiyūr (3,500 ft.); Sānthanpāra (3,500 ft.); Peermade (3,200 ft.); Camp Derāmalai (3,000 ft.); Kūriārkūtti (1,600 ft.); Nemmāra (300 ft.); Pādagiri (3,000 ft.); Karūpadanna (ca. S.L.).

[Additional specimens of *objurgatus* examined:
Brit. Mus. Coll.: ♂ ad. 2-12-78 Travancore (Bourdillon); [♂ ad.] ♀ 20-2-14 Aneichardi (Stewart); [♂ ad.] ?-3-75 Eridge (Bourdillon).

Measurements:

	Wing.	Tail.
3 ad. ♂♂	228-235	148-163 mm.
3 ♀♀	237-257	145.5-169 mm.—H. W.]

Colours of bare parts: Iris brown; eyelids, cere and basal portion of lower mandible greenish-yellow; bill plumbeous with horny brown tips; mouth greyish pink; tongue flesh coloured with dark tip; legs and feet bright chrome yellow; claws black.

The Indian Kestrel as a resident is fairly common but not abundant in Travancore and Cochin, in the low country as well as on the hills. During the breeding season it is probably commoner in the latter where it is said to nest on the crags and precipices. Its numbers are augmented in winter by the influx of the migratory European race, but the two are by no means easy to differentiate in the field.

The birds were usually met with singly, perched upon dead trees, telegraph poles or stones on grass-covered hillsides, in open cultivated country and by the backwaters. They also resorted to the stubble and scraggy grass-covered patches by the seashore. They frequently occupy the same look-out post day after day, and appear to have well-defined feeding territories. The birds either quarter the ground, hover and pounce upon their prey—field-mice, lizards, locusts etc.—or procure it in the manner of a shrike, swooping down on the ground from their perch and returning with it.

Both Fairbank (*S.F.*, v, 392) and Terry (*S.F.*, x, 469) found the Kestrel fairly common in the Palni Hills. The former observed it at 7,000 ft. elevation on Mount Nebo till the middle of June and considered it a permanent resident on the top of the Palnis.

The European race is found as a winter visitor in Ceylon, but there is no proof that the Indian Kestrel occurs there at all.

Breeding: Specimens Nos. 551 (9 April) and 573 (12 April) both had conspicuously granular ovaries—with the follicles measuring 1 mm. or more in diameter. They were apparently in pre-nuptial body moult and preparing to breed shortly.

T. F. Bourdillon (*J.B.N.H.S.*, xv, 673) observed a pair feeding their young in a nest on an inaccessible ledge of rock at ca. 2,800 ft. elevation during April.

Nidification (iv, 44) states that Bourdillon and Stewart knew it to breed in North and South Travancore and that it has also been obtained in June and July in the Nelliampathy Hills.

[**Aquila nipalensis** Hodgson. The Steppe Eagle.

North Travancore has been included in the distribution of this eagle (*Fauna*, v, 71) on the authority of J. Stewart. As Mr. Whistler has pointed out in the *Journal* (xxxviii, 423), however, eagles are notoriously difficult to identify, and, as Stewart apparently did not preserve the specimen for comparison with authentic examples, further proof is desirable before we can accept its occurrence within this area.]

[**Aquila pomarina hastata** (Lesson). The Small Indian Spotted Eagle.

The *Fauna* (v, 75) and *Nidification* (iv, 52) both say that this eagle is uncommon in Travancore. On what authority its occurrence is based is not known since no specimens apparently exist.]

Hieraëtus fasciatus fasciatus (Vieillot). Bonelli's Eagle.

Not met with by the Surveys, neither included in Ferguson's Travancore list. Apparently, however, Stewart took many nests in Travancore (*Nidification*, iv, 54).

Hieraaëtus pennatus (Gmelin). The Booted Eagle.

Not met with by the Surveys.

Ferguson (*J.B.N.H.S.*, xv, 669) describes the Booted Eagle as an occasional winter visitor to Travancore. The Trivandrum Museum in his time possessed a single specimen shot in that locality in February. I have seen another specimen in the same museum labelled: o? 5-11-93 Thottam.

Lophotriorchis kienerii (Sparre). The Rufous-bellied Hawk-Eagle.

Specimen not obtained.

Noted at Marāiyūr (above Kūmarikkaimalai, 7,000 ft.—10 January); Thattakād (200 ft.—8 February).

On both occasions single birds were observed soaring above afforested hillsides. The ferruginous underparts were conspicuous and diagnostic.

Ferguson says (*J.B.N.H.S.*, xv, 669) that the Rufous-bellied Hawk-Eagle is rare in Travancore. He shot an example at the foot of the hills in South Travancore in April 1901, and mentions that F. W. Bourdillon had a specimen given to him which was shot at an elevation of 2,200 ft. in the act of swooping at a chicken. According to the *Fauna* (v, 81) in Travancore it is commonest between 1,500 and 3,000 ft. elevation.

It is said to occur in Ceylon.

Breeding: A. M. Kinloch (*J.B.N.H.S.*, xvii, 1027) obtained a nest with a young bird in the Annemalai Hills in December 1906. Since then, Stewart (apud *Nidification*, iv, 57) has taken many nests and eggs in Travancore, and he gives a good account of its breeding habits. It evidently breeds in heavy forest between 1 and 4,000 ft. elevation, but principally between 1,500 and 3,000 ft. He took eggs—invariably c/1—from 27 November to the end of March.

Ictinaëtus malayensis perniger (Hodgson). The Indian Black Eagle.

Specimen not obtained.

Noted at: Marāiyūr (3,500-7,000 ft.); Sānthanpāra (3,500-5,000 ft.); Mūthūkūzhi, Ashāmbū Hills (at 4,000 ft.); Kūriārkūtti (1,600-4,500 ft.); Nemmāra (300-1,000 ft.).

This eagle is a fairly common and resident species in the well-wooded portions of both the States, from the foothills country up to the highest elevations. In the Nelliampathy Hills, Kinloch (*J.B.N.H.S.*, xxvii, 942) describes it as very common.

The birds were usually seen singly—sometimes in pairs—sailing majestically above the wooded ravines and hill-forest. In the Cardamom Hills, a trio (parents training full-fledged young?) were observed on one occasion indulging in a remarkable display of gliding, soaring and nose-diving above a grassy hilltop at ca. 4,000 ft. From my level, or a little below, they rose with no perceptible effort on motionless wings to about 200 ft. above in less than 15 seconds. Within a couple of minutes the birds were quite 5 to 600 ft. above me, without once flapping their wings. They were quite obviously disporting themselves for sheer pleasure.

Fairbank (*S.F.*, v, 392) observed 3 of these eagles at different places in the Lower Palnis at about 4,000 ft., circling slowly just above the tree-tops in the valleys.

It is found in Ceylon.

Breeding: According to *Nidification* (iv, 59) Stewart took eggs in Travancore at elevations between 1,000 and 4,000 ft., normally from November to February but also once on 9 September. The nests are said to be built in tall trees in evergreen forest, often so overgrown with creepers as to conceal the nest completely. Sometimes they are built in more conspicuous positions in opener trees. A single egg is usually laid, but very rarely 2 may be found.

Bourdillon gives a very different account of its breeding in Travancore. He says it builds on cliffs (!) at elevations of 2,000 ft. and upwards in January and February, laying from 1 to 3 eggs (*J.B.N.H.S.*, xv, 670).

Nisaëtus cirrhatus cirrhatus (Gmelin). The Indian Crested Hawk-Eagle.

Specimens collected: 12 ♂ 5-1-33 Marāiyūr 3,500 ft.; 248 ♂ 6-2-33 Thattakād 200 ft.

Elsewhere not noted.

Colours of bare parts: Iris bright lemon yellow; cere and rhampotheca slaty black, greenish-grey at gape and plumbeous at chin; mouth pink; feet dull yellow; claws black.

[The specimens measure:

	Bill.	Wing.	Tail.	Tarsus.
2 ♂♂	43-44	351-416	244-280	90-105 mm.

N.B.—The wing and tail of the bird with small measurements are very worn and are therefore somewhat below normal.—H. W.]

The Crested Hawk-Eagle is perhaps commoner in Travancore and Cochin than the Survey records suggest. Both the specimens were shot on the edge of mixed deciduous and evergreen forest.

According to Ferguson (*J.B.N.H.S.*, xv, 670) this species is common in the low country of Travancore and less so on the hills. In the Nelliampathy Hills, Kinloch (*J.B.N.H.S.*, xxvii, 943) found it very common. The former says it is very destructive to poultry, the latter that it feeds on Jungle Fowl.

Breeding: Specimen No. 12 (5 January) was presumably breeding. Its testes measured 19×9 mm.

Ferguson gives the breeding month in Travancore as March.

Nisaëtus cirrhatus ceylonensis (Gmelin). The Ceylon Crested Hawk-Eagle.

The *Fauna* (v, 87) and *Nidification* (iv, 64) both extend the distribution of this race to include South Travancore where Stewart claims to have found it very numerous and to have taken many eggs between early December and the end of March.

I do not know if Stewart ever actually collected specimens of the birds, and if so where these are at present, and whether he correctly attributed them to this form. The only Travancore specimen to which Mr. Whistler has had access is an 'Anjango' bird in the British Museum which is the type of Hume's *Spizaëtus sphynx* (*S.F.*, i, 319).

Nisaëtus nipalensis kelaarti Legge. The Ceylon Feather-toed Hawk-Eagle.

Specimens collected: 868 ♂ 15-11-36 Parambikolam, ca. 1,600 ft.—Annamalai Hills, Cochin.

Elsewhere not recognised or noted.

Colours of bare parts: Iris bright lemon yellow; bill including cere horny slate; mouth pink; feet dull yellow; claws black.

[The specimen ♂ measures:

Bill.	Wing.	Tail.	Tarsus.
46	402	261	98.5 mm.

Additional specimens examined:

Brit. Mus. Coll.: o 18-12-76, o 9-7-78, o juv. no date Mynall (Bourdillon). —H. W.]

This Hawk-Eagle is undoubtedly rare in Travancore where Ferguson says (*J.B.N.H.S.*, xv, 670) it is found as such only on the hills.

The specimen was killed with a stick by a fireman of the Cochin Forest Tramway in the act of swooping down on his chickens! Parambikolam is a cluster of a few huts at the terminus of the tramway amidst fairly heavy mixed deciduous and evergreen forest.

Breeding: The testes of the specimen were inactive. Stewart (apud *Nidification*, iv, 68) has taken nests and eggs in the Travancore hills, mostly between 1,000 and 3,000 ft., in dense evergreen forest. Occasionally also in deciduous forest with trees of immense size and considerable undergrowth. The nests are placed at heights of 80-100 ft. The season is said to be from December to the end of March most eggs being laid in January. C/1 is said to be the invariable rule.

Circaëtus ferox (Gmelin). The Short-toed Eagle.

Not met with by the Surveys.

Apparently no specimens exist from actually within the boundaries of Travancore or Cochin. A bird that died in the Trivandrum Zoo recently was sent for examination to Mr. Whistler by Mr. N. G. Pillai, the Museum curator. Regarding this specimen, the latter writes: 'From the Zoo records I can only make out that a couple of these birds were caught alive from Thiruppuramkunram, a village in the Tinnevelly District. The Zoo curator assures me that he has seen this species round about Arāmboli.'

As the Tinnevelly District of Madras adjoins Arāmboli in Travancore and the terrain in both these areas is very similar—light deciduous scrub jungle and cultivation—there is no reason to doubt the possibility of the Short-toed Eagle occurring here.

The species has not been recorded from Ceylon.

Breeding: According to *Nidification* (iv, 69) 'Stewart took two or three nests in the open on the outskirts of forest' in Travancore. The season is not specified, but it is given for most of its range as December to March.

Hæmatornis cheela melanotis (Jerdon). The Crested Serpent-Eagle.

Specimen collected: 63 ♂ 11-1-33 Marāiyūr 3,500 ft.

Elsewhere noted at: Mūnnār (5,000 ft.—Kanan Devan Hills); Sānthanpāra (3,500 ft.—Cardamom Hills); Thattakād (200 ft.); Peermade (3,200 ft.); Tenmalai (500 ft.); Balamore Estate (2,000-4,000 ft.—Ashāmbū Hills); Kūriārkūtti (1,600-2,500 ft.—Annemalai Hills); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Pādagiri (3,000 ft.—Nelliampathy Hills).

Colours of bare parts: Iris bright golden yellow; cere, skin above eye and eyelids lemon yellow; bill plumbeous, brownish on culmen and at tip; legs and feet dirty yellow; claws black.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ 22-1-67 Nundur; ♂ no date Travancore (Fry); ♂ 9-10-74, ♂ ?-3-76 Mynall (Bourdillon).

Trivandrum Mus. Coll.: ♂ 24-10-03 [Travancore].

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
6 ♂♂	42.5-46	357-434	211-279	91-106.5 mm.

For the supposed occurrence and breeding of both this and the Ceylon race at different altitudes in Travancore (*Nidification*, iv, 72-75) see Eastern Ghats Survey Report, *J.B.N.H.S.*, xxxviii, 426-27.—H. W.]

The Crested Serpent-Eagle is a fairly common resident species in the well-wooded tracts of Travancore and Cochin, evergreen as well as deciduous. It is found in the low country and up to at least 5,000 ft. in the hills, and no doubt higher still. The birds were usually observed in pairs, soaring and circling on motionless wings—often at great heights—above forest-clad hills and sholas, or perched in some lofty tree within or on the edge of forest. Its call of three loud, high-pitched screaming notes—*Kee-ki-ki* were commonly heard when the birds were soaring and helped to reveal thir identity at tremendous heights.

In the Palni Hills, Fairbank (*S.F.*, v, 392) only saw a single pair which would suggest that it is rather uncommon there.

In Ceylon it is replaced by the smaller race *H. c. spilogaster* Blyth.

Breeding: The testes of the specimen (11 January) were inactive. The bird was exceedingly fat. No first hand data as regards breeding was procured by the Surveys. Stewart (apud *Nidification*, iv, 72) found nests of this Serpent Eagle in trees beside the Pūnalūr, Kallar and Shencottah streams in Travancore, and gives the season as December to March. Only a single egg is said to be laid.

The same collector is also credited in *Nidification* with having found the Ceylon race breeding in some numbers chiefly between 500 and 2,000 ft. in the hills of South Travancore from January to March. As pointed out by Mr. Whistler, there seems to be some confusion here and further authentic data and material seem desirable in order to prove that both the forms do in fact occur and breed in Travancore. It is apparently not easy to trace the specimens collected by Stewart and on which his statements are based.

Butastur teesa (Franklin). The White-eyed Buzzard-Eagle.

Not met with by the Surveys.

Apparently overlooked as according to Ferguson (*J.B.N.H.S.*, xv, 670) it is not uncommon in the low country of South Travancore, but does not ascend the hills. However, under the circumstances I cannot but imagine that it must be somewhat rare since a large and familiar bird as this is not easy to miss.

Haliaeëtus leucogaster (Gmelin). The White-bellied Sea-Eagle.

Not met with by the Surveys, neither recorded in Travancore or Cochin by previous observers.

It is not known on what authority the definite statement in *Nidification* (iv, 78) that it breeds in Travancore is based. That it *may* occur and breed along the coast, however, is not improbable.]

Ichthyophaga ichthyaëtus (Horsfield) subsp.? The Grey-headed Fishing Eagle.

Specimen not obtained.

Noted at: Periyār Lake (3,000 ft.) Travancore (at Thekaday and Camp Derāmalai ends).

Several of these fine eagles were observed at long intervals, perched singly on tall forest trees by the margin of the lake, or soaring and circling high up in its vicinity. The birds seemed to be rare and were shy and difficult to approach.

Stuart Baker (*Nidification*, iv, 84) says that Travancore birds are intermediate between the typical race and *plumbiceps* of Ceylon, but nearer the former.

Breeding: Stewart found the Grey-headed Fishing Eagle breeding in Travancore and took eggs on 2 March (*Nidification*, iv, 82).

Haliastur indus indus (Boddaert). The Brahminy Kite.

Specimens collected: 710 o? 23-7-33, 735 ♀, 736 ♀ 27-7-33 Beach, Trivandrum.

Elsewhere noted at: Thattakād (200 ft.); Kōttayam (ca. S.L.); Vembanād Lake; Alleppey; Kūmili (Periyār Lake 3.000 ft.); Tenmalai (500 ft.); Cape Comorin (ca. S.L.); Shoranūr; Chālakūdi; Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Pādagiri (3,000 ft.); Karūpadanna (ca. S.L.); Ernākulam; Cochin Harbour.

Colours of bare parts: 'Iris yellowish-brown; bill horny black or dark plumbeous, yellowish at gape; mouth bluish-pink; legs and feet yellow; claws black' (Pillai).

[Additional specimens seen:

Brit. Mus. Coll.: ♂ ad. 25-3-77 Mynall (Bourdillon); ♀ ad. 28-2-75 Colachul (Hume Coll.).

Measurements:

	Bill.	Wing.	Tail.
1 ♂ ad.	38	359	180 mm.
2 ♀♀ ad.	33.5-36	379-391	189.5-200 mm.
1 ♀ imm.	33.5	378	197 mm.—H. W.]

The Brahminy Kite is a common resident species throughout the low country of Travancore and Cochin, and was also found locally and patchily on the hills up to at least 3,000 ft. It is commonest about the coast and backwaters, but was also noted as abundant at the Thekaday end of the Periyār Lake in the vicinity of the sluice gates. Numbers were usually to be seen here perched on the trunks and bare branches of the partly submerged trees. By the backwaters it lives chiefly by pilfering from the fish yards and on the large variety of garbage floating on the surface especially near the kopra depots and habitations, and in the harbours of Alleppey and Cochin. Mr. Pillai notes that one of the specimens had a number of tadpoles in its bill.

In the Nelliampathy Hills, Kinloch (*J.B.N.H.S.*, xxvii, 943) says that this kite only comes from the plains in fine weather as a temporary visitor, presumably not roosting on the heights. At Pādagiri, in the same hills, I observed 3 or 4 examples amongst a gathering of about 50 vultures at the scrappy remains of a Tahr that had been shot.

Both Fairbank and Terry include this species in their Palnis lists. The former found it abundant about tanks and ponds near the base of the Hills and observed it up to 4,000 ft. The latter saw a pair hawking about over the lake at Kōdaikānal.

The same race is a common resident in Ceylon.

Breeding: The gonads of the specimens (23 and 27 July) were in a quiescent state. In Travancore Bourdillon found most birds breeding in January and February (*Nidification*, iv, 87).

Milvus migrans govinda Sykes. The Common Pariah Kite.

Specimens not collected.

Noted at: Marāiyūr (3,500 ft.); Mūnnār (5,000 ft.); Sānthanpāra (3,500 ft.); Kōttayam (ca. S.L.); Peermade (3,200 ft.); Kūmili (3,000 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Trivandrum; Cape Comorin; Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Pādagiri (3,000 ft.); Trichūr; Karūpadanna; Ernākulam; Cochin.

The Pariah Kite is common and generally distributed in the low country of Travancore and Cochin about towns and villages, and is also found on the hills (up to 5,000 ft.!) by human habitations. It is less dependent on the neighbourhood of water than the Brahminy Kite, but the two are commonly found in association.

A few birds were usually to be seen in the vicinity of coolie lines even in remote cardamom, tea and coffee plantations. Here they are great chicken robbers and a source of continual annoyance to the owners.

Near Pādagiri (ca. 3,500 ft.—Nelliampathy Hills) 3 or 4 Pariah Kites were noted amongst a gathering of about 50 vultures at the scanty remains of a Nilgiri Tahr. According to Kinloch (*J.B.N.H.S.*, xxvii, 943) it ascends these hills only as a daily visitor from the plains, and like the Brahminy Kite, does not roost up there.

Fairbank (*S.F.*, v, 392) found the Pariah Kite common at the base of the Palni Hills, but did not notice one above 3,000 ft. Terry (*S.F.*, x, 469) says that it is rather scarce on the tops of the Palnis, and that he never saw more than one or two pairs in the same place. It is common in Ceylon.

Breeding: In November and December breeding was in full swing in the low country of Cochin. The birds were observed in copula very generally, and on 29 December an individual was noted carrying building material into a cocoanut palm at the edge of the backwaters.

According to Ferguson (*J.B.N.H.S.*, xv, 670) in Travancore it usually breeds during February and March.

Elanus caeruleus vociferus (Latham). The Black-winged Kite.

Specimens collected: 186 ♂ 30-1-33 Sānthanpāra 3,500 ft., Cardamom Hills.

Elsewhere noted at: Thattakād (200 ft.); Kūmili (3,000 ft.).

Colours of bare parts: Iris bright pale claret; bill horny black, cere and gape yellow; legs and feet yellow; claws horny black.

[The specimen ♂ measures:

Bill.	Wing.	Tail.	Tarsus.
22	273	124	30.5 mm.—H. W.]

In the experience of the Surveys, the Black-winged Kite is decidedly rare in Travancore and Cochin. Ferguson (*J.B.N.H.S.*, xv, 670) believed it to be only a winter visitor to Travancore. He had a specimen from Trivandrum and another from Sastancottah in the low country near Quilon, both killed in March. Kinloch (*J.B.N.H.S.*, xxvii, 943) considered it somewhat rare in the Nelliampathies, occasionally visiting the hills during the day and returning to the plains at night to roost. His remarks, however, do not suggest its seasonal status.

In Travancore it was met with singly in grassland and open deciduous and grass jungle, usually either perched on some favourite tree-stump or flying about with deliberate wing beats as of a Roller (*Coracias*) alternated with short spurts of sailing and hovering like a Kestrel. One of Ferguson's specimens had caught a lizard in its claws. Its food comprises mostly of these reptiles and of mice, locusts and grasshoppers.

Neither Fairbank nor Terry appear to have come across it in the Palni Hills. The same race is fairly well distributed in Ceylon.

Breeding: The gonads of the specimen (30 January) were inactive. No record of its breeding in Travancore or Cochin is available.

Circus macrourus (S. G. Gmelin). The Pale Harrier.

Specimen collected: 945 ♂ 5-12-33 Nemmāra 300 ft.

Elsewhere noted (this or *pygargus* ?): Marāiyūr (3,500 ft.); Peermade (3,200 ft.); Wadakkāncheri (400 ft.); Pādagiri (3,000 ft.).

Colours of bare parts: Iris greenish-yellow; cere and gape lemon yellow; rhampotheca horny black, plumbeous at base of lower mandible; mouth greyish-pink; legs and feet pale chrome yellow; claws black.

[Additional specimens seen:

Brit. Mus. Coll.: ♀ 28-12-75 Colathoorpolay Valley 3,000 ft. (Bourdillon); o? 22-2-14 Aneichardi Estate (Stewart).—H. W.]

The Pale Harrier is a winter visitor to Travancore and Cochin and found in the low country and hills alike. Ferguson (*J.B.N.H.S.*, xv, 671) obtained it at 6,000 ft. on the High Range. It frequents paddy cultivation, fallow land and the open hillsides as at Peermade, covered with grass tussocks intermingled with bracken bushes and stunted *Phoenix* palms. It quarters the ground on outspread motionless wings, sailing gracefully a few feet above the surface and pouncing now and then on some lizard, locust, mouse or frog.

It is a winter visitor also to Ceylon.

Circus pygargus Linnaeus. Montague's Harrier.

Specimen not obtained.

Noted (see under *macrourus*).

According to Ferguson (*J.B.N.H.S.*, xv, 671), Montague's Harrier is a winter visitor to the plains as well as hills of Travancore, arriving about a month later than the foregoing species, i.e. in December.

Circus melanoleucus (Pennant). The Pied Harrier.

Specimen collected: 83 ♂ 13-1-33 Marāiyūr 3,500 ft.

Elsewhere not noted.

Colours of bare parts: Iris bright lemon yellow; cere lemon yellow; rhampotheca horny back, plumbeous at gape and basal portion of lower mandible; mouth pinkish slate; legs and feet chrome yellow; claws black.

[Additional specimen seen:

Brit. Mus. Coll.: o? 18-4-77 Colathoorpolay Patnas 3,800 ft. (Bourdillon). —H. W.]

The Pied Harrier is evidently a scarce winter visitor to Travancore, and probably Cochin as well. There is, however, no record from the latter. The specimen was a solitary bird perched on a mound in a dry stubble field.

Ferguson (*J.B.N.H.S.*, xv, 671) says it visits Travancore occasionally, staying on later than the other harriers. He saw specimens in the beginning of April.

It is a rare winter visitor to Ceylon.

Circus æruginosus æruginosus (Linn.). The Marsh Harrier.

Specimens collected: 304 ♀ 18-2-33 Kōttayam (Vembanād Backwaters).

Elsewhere noted at: Vellayāni Lake (near Trivandrum); Arāmboli (300 ft.); Nemmāra (300 ft.); Karūpadanna (backwaters).

Colours of bare parts: Iris hazel brown; cere yellow; rhampotheca horny black, plumbeous at gape and chin; legs and feet yellow; claws horny black.

The Marsh Harrier is, as Ferguson remarks (*J.B.N.H.S.*, xv, 671), the commonest harrier in Travancore during the cold weather, and to this I can add Cochin also. It is, however, confined to the low country where, as its name implies, it is found about water-logged paddy fields or shallow tanks with grass and reeds, and in the vicinity of the backwaters. It is almost invariably met with as a solitary bird. Ferguson found it in Travancore from October to April. The last date the Survey has recorded is 21 April.

It is a winter visitor also to Ceylon.

Buteo buteo burmanicus Hume. The Japanese Desert-Buzzard.

Not met with by the Surveys.

Ferguson (*J.B.N.H.S.*, xv, 671) states that he often saw these birds on the grass land at Pōnmūdi, but that the Trivandrum Museum possessed no specimens. Regarding a specimen collected in Travancore by F. W. Bourdillon and identified by Hume as *plumipes*, Mr. Whistler remarks (*J.B.N.H.S.*, xxxviii, 431) that this is, in reality, the smaller form *burmanicus* which is undoubtedly the one that visits south-west India in winter.

Bourdillon (*S.F.*, iv, 358) writes: 'This bird, a winter visitor, seems to be not uncommon during December, January and February, preferring high open country where 2 or 3 may be seen steadily quartering the ground and occasionally pouncing on some mouse or lizard. I have seen them perch both on trees and on stones, and once saw one as low as 2,000 ft. elevation, where it was beating forwards and backwards over a field of young coffee.'

This Buzzard is a winter visitor also to Ceylon.

Astur badius badius (Gmelin). The Ceylon Shikra.

Specimens collected: 423 ♀ 7-3-33 Kūmili 3,000 ft.; 555 ♀ ad., 556 o? and 557 o? downy chicks 10-4-33 Cape Comorin ca. S.L.; 776 ♀ 3-8-33 Kōvalam ca. 70 ft.—Trivandrum Environs.

Elsewhere noted at: Maraiyūr (3,500 ft.); Mūndakāyam (Ūrūmbikera Forest, ca. 1,000 ft.); Rājampāra (1,350 ft.); Wadakkāncheri (400 ft.); Nemmāra (300 ft.).

Colours of bare parts: *Adult* (♀): Iris bright yellow; cere greenish yellow, rhampotheca plumbeous, blackish on upper mandible except at base; legs and feet greenish yellow; claws horny black. *Downy nestling*: Iris greyish-brown; cere and gape creamy yellow; rhampotheca horny black, bluish-grey at base; mouth pink; tip of tongue blackish; legs and feet pale greenish-yellow; claws plumbeous.

[Additional specimens seen:

Brit. Mus. Coll.: ♂♂♀ no date Aneichardi Estate (Stewart).

Measurements:

	Bill.	Wing.	Tail.
3 ♂♂ ad.	20-20.5	172-180	128-131 mm.
4 ♀♀ ad.	22-23	186-206	149.5-161 mm.

Measurements include a Fry Collection bird without precise data.

Travancore birds are really intermediate between this and *dussumieri*, but in the Eastern Ghats Survey I have decided that it is better to keep them with *badius*.

Dr. C. B. Ticehurst reports on the down plumage as follows: 'Down short, dense, covering nearly all the body, apparently prepennae and preplumulae mixed. White below, buffy white above and on wings.'—H. W.]

The Ceylon Shikra is a common resident species in Travancore and Cochin, principally in the low country about villages and cultivation, but it was also met with by the Surveys up to about 3,500 ft. elevation in fairly open deciduous jungle. It avoids evergreen forest. It was not observed around Pādagiri

(3,000 ft.), but was common at Nemmāra at the northern base of the Nelliampathies. Kinloch, however, lists it as 'common' on these hills (*J.B.N.H.S.*, xxvii, 943).

Neither Fairbank nor Terry record it in the Palni Hills. It is a common resident also in Ceylon.

Breeding: Nos. 556 and 557 (10 April) were downy nestlings and 555—with ovaries reverting to non-breeding condition (follicles ca. 1-1.5 mm.)—their mother. The nest was built of twigs etc.—very like a crow's at the base of the leaf-stalks in a *Borassus* palm amidst sparse scrub and cultivated country. The owners beat off crows and other birds from its proximity, but made no effort at defence when the nest was climbed up to. From the behaviour of other pairs also, it was evident that the birds were breeding generally at this time.

According to Bourdillon the season in Travancore is January to April, the normal clutch comprising of 3 to 4 eggs. Stewart found the birds commonly building in rubber trees in rubber estates. Kinloch took eggs on the Nelliampathy Hills on 27 March (*Nidification*, iv, 102).

Astur trivirgatus trivirgatus (Temm. & Lang.). The Crested Goshawk.

Not met with (overlooked?) by the Surveys.

Ferguson (*J.B.N.H.S.*, xv, 672) describes the Crested Goshawk as resident but by no means common in Travancore. Kinloch (*J.B.N.H.S.*, xxvii, 943) seems to have found the species common in the Nelliampathy Hills. His identification is confirmed by a specimen he collected in December 1923 and sent to Mr. Whistler.

It is said to affect heavy jungle (F. W. Bourdillon, *S.F.*, iv, 355).

Breeding: According to Stewart and Bourdillon (*Nidification*, iv, 107) this hawk breeds in Travancore from the foothills up to 3,000 or 3,500 ft. They have taken eggs—c/2 or c/3—from 2 March to 25 May, the latter being an unusually late date. On 14 April, Bourdillon found a nest at Mynall containing two juvenile birds.

Accipiter nisus nisosimilis (Tickell). The Asiatic Sparrow-Hawk.

Not met with by the Surveys.

Ferguson (*J.B.N.H.S.*, xv, 672) lists this species as a rare winter visitor to Travancore. He mentions F. W. Bourdillon securing a single specimen on the hills (Mynall 2,400 ft., *S.F.*, vii, 33). This—an immature ♀—is now in the British Museum Collection.

Mr. Whistler has also examined the only other Travancore specimen in the British Museum—an immature ♂—collected by Fry.

Accipiter virgatus besra Jerdon. The Southern Besra Sparrow-Hawk.

Specimen not obtained.

Noted at Pādagiri (3,000 ft.—Nelliampathy Hills).

Ferguson does not include this species in his Travancore list, but Stuart Baker, evidently on the authority of J. Stewart, says (*Nidification*, iv, 112-13) that it is common in Travancore and on the Malabar Coast, but seems to be rare elsewhere. It is described as a bird of deep evergreen forest from 2,000 to 4,000 ft. elevation or higher.

Kinloch (*J.B.N.H.S.*, xxvii, 943) found it 'very common' in the Nelliampathy Hills, where the Cochin Survey also came across it on two occasions. Solitary birds were observed perched on tall dead trees on the verge of evergreen jungle.

The same race occurs also in Ceylon.

Breeding: According to *Nidification*, Stewart took nests and eggs of this Sparrow-Hawk in Travancore between January and May. Most eggs were found in March and April. The normal clutch consists of 3 or 4 eggs.

Pernis ptilorhynchus ruficollis Lesson. The Indian Crested Honey-Buzzard.

Specimen not obtained.

Noted at: Sānthanpāra (3,500 ft.—Cardamom Hills); Peermade (3,200 ft.); Kūmili and Periyār Lake Environs (3,000 ft.); Camp Derāmalai (3,000 ft.—Panthalam Hills); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Arāmboli (250 ft.); Balamore Estate (2,000-3,000 ft.—Ashāmbū Hills).

The Honey-Buzzard was not uncommon in the well-wooded tracts of Travancore State, but not abundant. Usually single birds were observed soaring or circling above sholas. It has a high-pitched, rather prolonged whistling scream *wheew*.

Ferguson (*J.B.N.H.S.*, xv, 672) secured a single specimen at 'Peermade' near the Periyār Dam in January 1901, and considered the species a rare winter visitor to Travancore. Its status, however, has apparently not been properly determined.

Kinloch does not include the Honey-Buzzard in his Nelliampathies list, and strangely enough the Survey likewise failed to record it in Cochin during November and December.

It is found in Ceylon possibly as an immigrant, but its status in the island is also uncertain.

Baza leuphotes leuphotes (Dumont). The Indian Black-crested Baza.

Not met with by the Surveys.

Mr. Whistler has examined a specimen in the British Museum, collected by Stewart in Aneichardi Estate, Travancore, on 19 February 1914.

Breeding: According to *Nidification* (iv, 120) Stewart obtained nests of this species frequently at 2,000-2,500 ft. elevation in Travancore. He took most eggs in March and April—as early as 10 February and also as late as 4 July. The normal is said to be c/2 or c/3.

Baza jerdoni ceylonensis Legge. Legge's Baza.

Not met with by the Surveys.

Stewart, the only observer to record this species in Travancore, states (*Fauna*, v, 176) that it is rare and difficult to locate.

Breeding: The same observer is credited (*ibid.*, 175) with having taken nests and a very fine series of eggs of this Baza in Travancore. According to him, the breeding season in this area is from February to the end of April, the normal clutch consisting of 2 or 3 eggs.

ORDER: COLUMBÆ.

FAMILY: COLUMBIDÆ.

SUBFAMILY: TRERONINÆ.

Crocopus phœnicopterus chlorigaster (Blyth). The Southern Green Pigeon.

Not noted by the Surveys.

The Southern Green Pigeon was evidently not observed by Ferguson either in Travancore. There is no information concerning it in this area beyond that given below under 'Breeding', and it must be pointed out that no Travancore specimens are available for examination, which makes the use of the trinomial somewhat conjectural.

In the Nelliampathy Hills, Kinloch (*J.B.N.H.S.*, xxvii, 943) describes this species as very common in October, November and December. Its exodus from those hills begins about the middle of January and none are to be seen after the middle of February. Occasionally, however, a few birds remain behind to breed.

Fairbank (*S.F.*, v, 408) obtained this Green Pigeon in the avenues near the northern base of the Palni Hills. Terry (*S.F.*, x, 479) took a nest with one fresh egg in the Pittur Valley on 7 April, but did not meet with the species at higher elevations.

Breeding: *Nidification* (iv, 127) records the taking of its eggs in Travancore by Stewart in January.

Dendrophassa pompadora affinis (Jerdon). The Grey-fronted Green Pigeon.

Specimens collected: 401 ♂ 5-3-33 Kūmili 3.000 ft.; 644 ♂ 23-4-33 Balamore Estate 2,500 ft.—Ashāmbū Hills; 687 ♂ 18-7-33 Pūlayanārkotta ca. 200 ft.—Trivandrum Environs.

Elsewhere noted and/or shot at: Sānthanpāra (3,500 ft.—Cardamom Hills); Thattakād (200 ft.); Peermade (3,200 ft.); Wadakkāncheri (400 ft.); Pādagiri (3,000 ft.—Nelliampathy Hills).

Colours of bare parts: Iris, outer ring bright pink, inner ring lapis blue; bill, cere and lower mandible near gape yellowish-green rest pale grey; mouth yellowish grey-pink; legs and feet dull magenta or plum colour ('Deep red'—Pillai); claws horny grey; soles yellow.

[Additional specimens seen:

Brit. Mus. Coll.: ♂ 13-12-78 Mynall (Bourdillon); ♂ 7-1-73 Assambo Hills (Hume Coll.).

Sparrow Coll.: ♂ 20-3-14 Cardamom Hills.

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
4 ♂♂	19-20	143.5-147	88	20-23 mm.—H. W.]

The Grey-fronted Green Pigeon is a common species in the well-wooded portions of the low country of Travancore and Cochin, and extends through the foothills upward to at least 4,000 ft. elevation. It is said to be an altitudinal migrant to some extent. Kinloch (*J.B.N.H.S.*, xxvii, 943) states that in the Nelliampathy Hills it becomes increasingly common as *chlorogaster* becomes scarce; it is extremely common there during February and March, but that it also goes down to the low country before the burst of the South-West Monsoon.

The Surveys usually came across the birds in small flocks of up to a dozen or so. When not feeding they are fond of perching on dead or leafless trees on the edge of jungle and uttering their mellow whistling calls.

In the Palni Hills, Fairbank (*S.F.*, v, 408) obtained specimens of this Green Pigeon at Periur, where flocks came to feed on ripening *Zizyphus* fruits.

The typical race is abundant in Ceylon up to 4,000 ft.

Breeding: A female shot on 18 December at Pādagiri had a complete oviduct egg and the largest ovarian follicles measuring 12 mm. in diameter. In these hills Kinloch records this species as breeding solely in January and February.

Specimen No. 401 (5 March) was also breeding as evidenced by the testes which had enlarged to 13×7 mm.

T. F. Bourdillon found a nest with one egg in the Ashāmbū Hills at 2,400 ft. on 24 February.

Dendrophassa bicincta subsp.? The Orange-breasted Green Pigeon.

Not met with by the Surveys.

Ferguson (*J.B.N.H.S.*, xvi, 1) says that this species is by no means as common in Travancore as the foregoing, but that it may be met with in the low country forest not far from the coast.

In Ceylon it is replaced as a common coastal species by *D. b. leggei*.

Breeding: *Nidification* (iv, 131) records that Stewart found breeding in Travancore birds which almost certainly belonged to the Ceylonese race. It is perhaps preferable, however, to keep this binomial for the present in view of the difficulty explained by Mr. Whistler (*J.B.N.H.S.*, xxxviii, 673-4) over the correct names of the races of this bird. No specimens are available from the typical locality to show to which form the typical name should be rightly applied.

Ducula badia cuprea (Jerdon). Jerdon's Imperial Pigeon.

Specimen collected: 409 ♀ 6-3-33 Kūmili 3,000 ft.

Elsewhere shot and/or noted at: Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Peermade (3.200 ft.); Camp Derāmalai (3,000 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Balamore Estate and Mūthūkūzhi (between 2,500 and 4,000 ft.—Ashāmbū Hills); between Kūvallé Incline and Kūriārkūtti (Cochin Forest Tramway); Pādagiri (3,000 ft.).

Colours of bare parts: Iris brown; eyelids magenta; bill magenta except corneous tip which horny brown; legs and feet magenta; claws like tip of bill.

[Additional specimens seen: 7 specimens (November-December, January-March) Mynall (Bourdillon) in British Museum.

Sparrow Coll.: ♀ 9-3-14 Cardamom Hills.

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
2 ♂♂	32	221-228	—	—
7 ♀♀	30-33.5	225-235	164-174.5	29.5-31 mm.—H. W.]

Jerdon's Imperial Pigeon is a common resident species in the evergreen biotope of Travancore and Cochin. It was met with chiefly in the heavily forested foothills, and in wooded ravines and sholas at elevations up to at least 4,000 ft. It was usually observed singly or in pairs—occasionally 3 or 4 birds together. Its loud, throaty, booming calls *gu-gu- - -goo* and *goo-goo-goo*, rising in crescendo, commonly resounded through the forest. In timbre and volume these may be placed between the call of the Crow Pheasant and that of the *Entellus* or Langūr Monkey.

This Pigeon has evidently not been recorded in the Palni Hills though it must doubtless occur there. It has doubtfully been recorded as breeding in Ceylon.

Breeding: The specimen (16 March) was ready to breed shortly. Its ovary was mature, the largest follicle measuring over 7 mm. in diameter. On 16 March (Camp Derāmalāi) two twig nests, about 30 ft. apart, were noted in a large Ficus tree about 25 ft. up, within a mixed shola, off which the sitting birds were disturbed. From the general behaviour of the pigeons about this time, breeding was undoubtedly in full swing. On one occasion, a remarkable display of antics were observed. A bird—presumably male—launched itself into the air from a lofty branch. After flying some distance it suddenly closed its wings, and utilising the momentum shot upwards almost perpendicularly for 30 ft. or so. On the crest of the wave, as it were, the bird turned round and nose-dived, wings still closed. When back to about its former level, it flew a few yards more horizontally with great velocity and then suddenly closing its wings repeated the manoeuvre again. These acrobatics were reminiscent of the breeding display of the Roller (*Coracias*), but were infinitely more spectacular.

According to Stewart and Bourdillon (*Nidification*, iv, 139) the breeding season in Travancore is January to May. The latter says that it has two broods a year—in April and again in November. Only one egg is said to be laid at a time.

Muscadivora ænea pusilla (Blyth). The Ceylon Imperial Green Pigeon.

Specimen not obtained.

Noted at Thattakād (200 ft.).

[The only Travancore specimen I have examined is an unsexed 'Anjengo' skin in the British Museum. Bill 31; wing 210 mm.—H. W.]

According to Ferguson (*J.B.N.H.S.*, xvi, 2) this fine pigeon is only found in the low country forests in Travancore, and he is doubtless correct. The Travancore Survey only came across it at Thattakād, where it was not uncommon in the mixed deciduous-and-evergreen jungle.

It was not met with by the Cochin Survey. Kinloch (*J.B.N.H.S.*, xxvii, 943) describes it as rare in the Nelliampathy Hills and occurring only towards the foot of the Southern slopes. He thought it may probably be common in the immense forests of the Nelliampathy Valley.

Fairbank and Terry do not record it in the Palni Hills. It is apparently a common resident in Ceylon.

Breeding: Stewart and Bourdillon took many nests and eggs in Travancore in February, March, April and June (*Nidification*, iv, 142).

Chalcophaps indica indica (Linn.). The Indian Emerald Dove.

Specimens collected: 9 ♂ 4-1-33 Marāiyūr 3,500 ft.; 987 ♂ juv. 16-12-33 Pādagiri (at 4,000 ft.).

Elsewhere noted at: Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Peermade (3,200 ft.); Camp Derāmalai (3,000 ft.); Rājampāra (1,350 ft.); Tenmalai (500 ft.); Balamore Estate (2,000-3,000 ft.); Kūriārkūtti (1,600 ft.).

Colours of bare parts: *Adult*: Iris brown; bill coral red, magenta on cere; legs and feet pinkish red; claws horny-brown. *Juvenile*: Iris brown; bill slaty brown with ivory tip; orbital skin slaty brown; mouth pink; legs and feet pinkish-grey; claws horny brown.

[Additional specimens examined:
Brit. Mus. Coll.: ♂ 29-2-76, ♀ 2-11-78, ♀ 14-1-76 Mynall 2,400 ft. (Bourdillon); also 2 Peermade skins no date (Fry).

Measurements:

	Bill.	Wing.
4 ♂♂	21-23.5	153-157 mm.

The juvenile of both sexes resembles the adult female, but the green is confined to the mantle and a broad band across the median and lesser wing coverts; the green is duller without any trace of blue in it, the feathers are more 'decomposed' and some are tipped with a band of rufous brown. Remainder of coverts and wing-quills dark brown, most of the feathers edged and tipped and with their inner web marked with rufous brown, some of the inner coverts being largely of this colour. Lower plumage, except for the pale chin and throat, uniform brown, darker than in the adult, the feathers faintly vermiculated and narrowly barred with dull black, especially on the breast and flanks. Under tail coverts black.—H. W.]

The Surveys found the Emerald Dove common in the forested tracts of Travancore and Cochin, both in the low and foothills country as well as up to about 4,000 ft. in the hills. The birds were almost invariably seen singly or in pairs, feeding on the ground along paths or roads through jungle and coffee or cardamom plantations. At Marāiyūr they were noted as partial to the Castor plants which spring up so luxuriantly in old abandoned taungya clearings, amongst whose branches they were almost invariably to be met.

Specimen No. 9 was a casualty caused by impact of the bird dashing itself against the whitewashed wall of a building. I was told that Bronze-winged Doves here were constantly coming to grief in this way and numbers had been picked up from time to time lying dead at the foot of this wall. The birds, flying as they do at great speed, no doubt take the sunlit patches of this wall (as seen through the dense surrounding shrubbery) to be the open sky and rush towards it with fatal results to themselves.

In the Palni Hills the status of the Emerald Dove is probably the same as in our area. Fairbank (*S.F.*, v, 409) shot one and saw another at Periur and Terry (*S.F.*, x, 479) obtained a specimen at Pulungi.

In Ceylon the endemic race *C. i. robinsoni* is generally distributed.

Breeding: The testes of the adult specimen (4 January) measured 6×4 mm. 987 (16 December) was a juvenile just growing rectrices, remiges and contour feathers. It was one of a brood of two, out of nest, in a dense evergreen patch in a ravine at ca. 4,500 ft. elevation. The young birds flew up noiselessly from the ground, in and out through cane brakes etc., settling again at a short distance, remarkably like a nightjar. Indeed in the poor light and amidst the dense vegetation they were at first actually mistaken for that bird!

Bourdillon says that in Travancore this dove breeds in April-May and again in November-December, and Kinloch found the same to be the case on the Nelliampathy Hills (*Nidification*, iv, 147).

SUBFAMILY: COLUMBINÆ.

Columba livia intermedia (Strickland). The Indian Blue Rock Pigeon.

Specimens not collected. No Travancore or Cochin specimens have been available to Mr. Whistler for examination, hence the trinomial is merely conjectural.

Noted at: Marāiyūr (3,500 ft.); Cape Comorin, Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Karūpadanna (ca. S.L.).

Most of the Blue Rock Pigeons met with in Travancore and Cochin were in all probability tame or semi-domesticated birds. They were usually observed gleaning in cut paddy fields etc. in the vicinity of villages but were nowhere common or abundant.

A small colony living in the ceiling and among the rafters of the outhouses of the Travellers' Bungalow at Karūpadanna provided the Survey party with the welcome change of Pigeon-pie on several occasions!

According to Ferguson (*J.B.N.H.S.*, xvi, 2) during the dry months these pigeons ascend the hills up to 2,500 ft. elevation in South Travancore, feeding there during the day and returning in the evening to their roosting places in the low country. The colony referred to by Ferguson in 1904 on the rock that rises out of the sea at Cape Comorin, was observed to be in occupation still (1933).

Fairbank (*S.F.*, v, 408) did not find this species abundant on the Palni Hills. He observed a flock by the fall of Levinge's brook. Terry (*S.F.*, x, 479) records a large colony on the cliffs near Pittur.

It has a very local distribution in Ceylon.

Breeding: Nothing appears to be recorded about the season in our area.

Columba elphinstonii (Sykes). The Nilgiri Wood Pigeon.

Specimens collected: 60 ♂ 10-1-33 Marāiyūr 3,500 ft.; 146 o? 24-1-33 Sānthanpāra 3,500 ft.

Elsewhere noted at: Thattakād (200 ft.).

Colours of bare parts: Iris (60) bright khaki, (146) pale khaki or greyish-brown; bill, basal half including cere magenta; corneous portion old ivory white; mouth greyish-pink; legs and feet magenta; claws greyish ivory-white.

[Additional specimens examined:

Brit. Mus. Coll.: ♂ ♀ 22-6-77, ♀ 23-6-77 Kodaikanal 7,000 ft. (Fairbank); ♀ 28-9-74, ♂ imm. 5-10-74 Mynall (Bourdillon).

Measurements:

	Bill.	Wing.	Tail.
1 ♂	27	203	—
1 ♀	27	202	158 mm.

No. 146 appears to be in juvenile plumage, similar to that of the adult but with the neck-spotting duller, less clearly defined.—H. W.]

The Nilgiri Wood Pigeon was not uncommon in the evergreen forest tracts of Travancore, chiefly in the hills but also lower down, e.g. Thattakād (200 ft.). Single birds or pairs were met with amongst tall trees in forest and cardamom sholas.

Ferguson (*J.B.N.H.S.*, xvi, 3) found it common at the summits of the hills in South Travancore and at Peermade, and also on the High Range. Kinloch does not include this pigeon in his Nelliampathies list (*J.B.N.H.S.*, xxvii), but in *The Birds of South India* he is quoted as having found it sparingly in those hills.

In the Palnis, Fairbank (*S.F.*, v, 408) obtained it both in the Kodaikanal at 7,000 ft. and on the lower hills at 4,000 ft. Terry (*S.F.*, x, 479) describes it as common in most of the big sholas there.

In Ceylon it is replaced by another species, *C. torringtonii.*

Breeding: The gonads of the specimens furnished no clue in regard to breeding. According to Stewart (*Nidification*, iv, 155) this pigeon breeds in the Travancore ranges from 4,000 ft. up. He only once took an egg, but omits to give the date.

Capt. Horace Terry obtained a nest with one egg at Kukal in the Palni Hills on 17 May. *Nidification* (iv, 154) gives the general breeding season as from March to July, most eggs being laid in May and June.

Streptopelia chinensis suratensis (Gmelin). The Indian Spotted Dove.

Specimens collected: 695 ♂ 20-7-33 (Thirūmalai ca. 120 ft.), 858 ♂ downy nestling, 859 o? downy nestling (nest twin of 858) 2-8-33 (Golf Links ca. 100 ft.) Trivandrum Environs.

Elsewhere noted at: Marāiyūr (3,500 ft.); Sānthanpāra (3,500 ft.); Thattakād (200 ft.); Kōttayam (ca. S.L.); Kūmili (3,000 ft.); Rājampāra (1,350 ft.); Cape Comorin; Arāmboli (250 ft.); Wadakkāncheri (400 ft.); Nemmāra (300 ft.); Karūpadanna (ca. S.L.).

Colours of bare parts: '*Adult*: Iris claret; bill horny black; mouth slaty; legs and feet red; claws horny brown. *Nestling*: Iris bluish black; bill upper mandible slaty, darker near tip, whitish near base; lower mandible horny black tipped brownish-white; legs and feet brownish-black; claws horny brown, tipped paler'—(Pillai).

[Additional specimens examined:

Brit. Mus. Coll.: ♂ 15-6-77 Periur, Lower Palnis, 4,000 ft. (Fairbank); o? 21-6-77 Vellarney Lake (Hume Coll.).

Measurements:

	Bill.	Wing.
2 ♂♂	18-19	139-140 mm.

A note on the moult of this race will be found in *Ibis*, 1935, p. 437.—H. W.]

The Spotted Dove is a common and resident species in Travancore and Cochin. It was met with both in the low country and on the hills up to about 3,500 ft. elevation, but was noted as definitely absent at Mūnnār (5,000 ft. High Range). According to Ferguson (*J.B.N.H.S.*, xvi, 3), however, it ascends the hills in the dry weather only. In most of the localities mentioned, it was the only species of dove to occur. The birds were usually observed in pairs, in the neighbourhood of cultivation and human habitations, gleaning seeds and paddy grains in harvested fields and on fallow land.

Kinloch's Nelliampathies list does not include this dove, and the Cochin Survey also failed to observe it at Pādagiri (3,000 ft.) on these hills during December.

Both Fairbank and Terry (*S.F.*, v, 409 and x, 479) say that it is very common in the Palnis, on the lower hills as well as at the base, especially near villages.

In Ceylon, the endemic race *S. c. ceylonensis* replaces it and is abundant up to 3,000 ft. elevation.

Breeding: On 6 December (Nemmāra) a nest was discovered on a horizontal teak branch ca. 16 ft. up, in open deciduous forest, containing 1 egg and 1 chick just hatched out. On 10 January (Marāiyūr) a pair were observed in copula. The testes of No. 695 (20 July) measured 7 × 5 mm. On 2 August Mr. Pillai saw a nest ca. 5 ft. up on a beam supporting creepers in a garden at the Trivandrum Golf Links. It was the usual flimsy 'two cross-twig' platform, and contained 2 eggs. The downy specimens were taken from another nest on the same date.

According to Bourdillon (*J.B.N.H.S.*, xvi, 3) in Travancore the Spotted Dove has 2 or 3 broods in the year. It would perhaps be more correct to say that it breeds here more or less all the year round.

Terry (*S.F.*, x, 479) obtained a nest with two eggs at Pittur in the Palni Hills at the end of April.

Streptopelia senegalensis cambayensis (Gmelin). The Indian Little Brown Dove.

Specimen not collected.

Noted only at Arāmboli in dry open country with boulder hillocks, cactus and sparse scrub. Here it was noticeably commoner than the Ring or Spotted Dove, but not abundant.

Ferguson says about it (*J.B.N.H.S.*, xvi, 3) '. . . by no means common and is only to be found in the dry region of the extreme South [of Travancore] not far from Cape Comorin.'

In the Palnis Fairbank (*S.F.*, v, 408) observed it at the base of the hills and on the lower hills, while Terry (*S.F.*, x, 479) records it from the slopes below Pulungi and in the Pittur Valley, where it is not common.

It does not occur in Ceylon.

Breeding: There is no published record of its breeding in Travancore or Cochin.

Streptopelia decaocto decaocto (Frivalsky). The Indian Ring Dove.

Specimen not obtained.

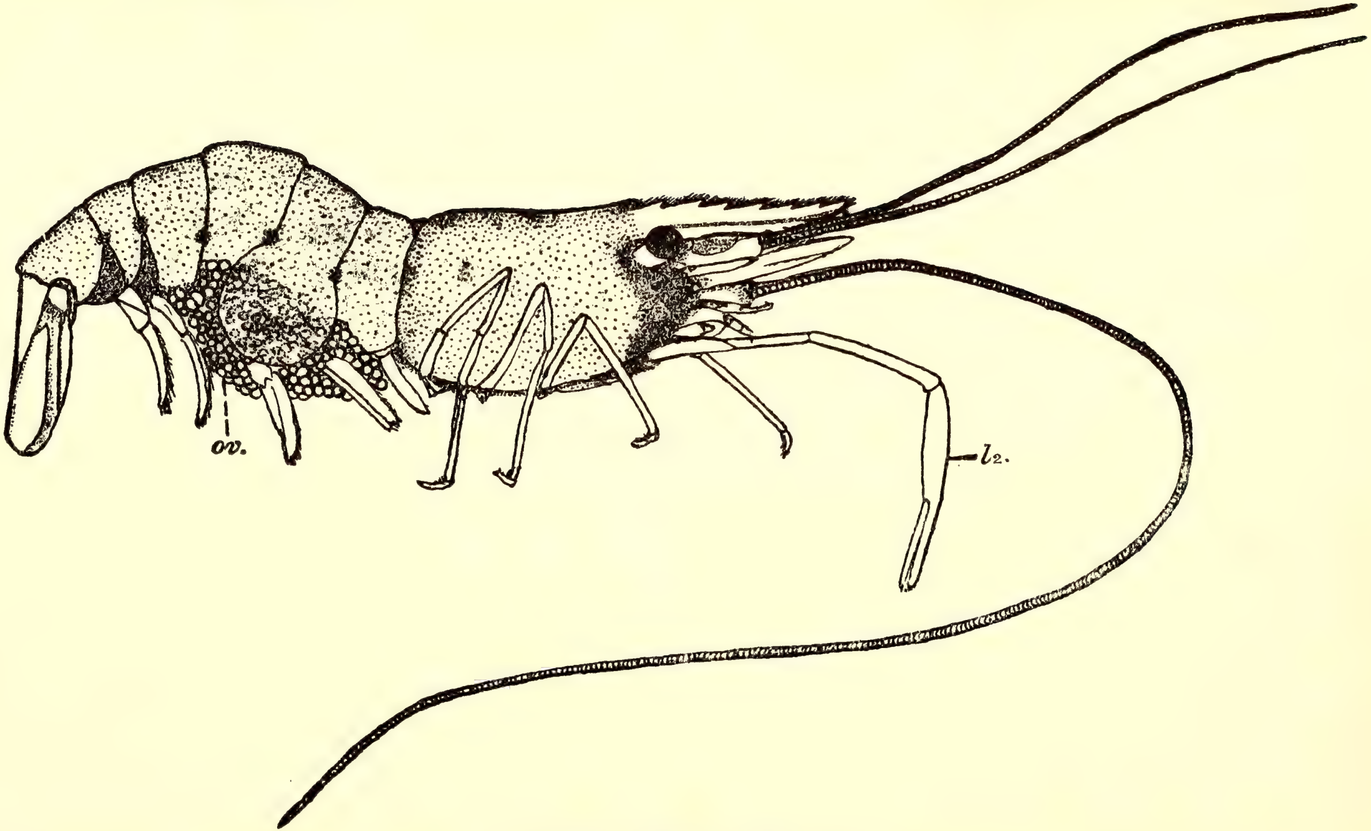
Noted only at Cape Comorin and Arāmboli, frequenting scrub and boulder country with scattered cultivation. It was decidedly rare.

In the Palnis, Fairbank (*S.F.*, v, 409) found it in the plains, presumably at the base of the hills, and Terry (*S.F.*, x, 479) in the Pittur Valley, but they both mention that it is not common.

It has a local distribution in North-West Ceylon.

Breeding: No information with regard to its breeding in our area is available.

(*To be continued*).



An ovigerous female of *Palaemon* sp.

For explanation see end of article.

THE PRAWN INDUSTRY OF THE MALABAR COAST.

BY

[1]N. Kesava Panikkar, M.A., M.SC.

(*With three plates*).

Introduction.

Though the resources of the prawn fisheries of the backwaters adjoining the south-west coast of India have been realized by the people long ago, only very recently have attempts been made to take the best advantage of the highly favourable physical and biological conditions enabling the culture of edible prawns on a large scale. As fresh prawns have a ready local market, they are caught and sold at random wherever they are available, and only in a few localities do we find prawn fishing conducted on an industrial basis, allowing of regular exports to other places. The importance of the industry has been realized only by a few even in these days and there is much to be done for the betterment of the existing conditions. There is excellent scope for prawn culture and prawn fishing in Malabar and the States of Travancore and Cochin; with properly planned marketing facilities, this will become an important commercial occupation as on the Bombay and Sindh coasts, if proper attention be paid both by the governments concerned and by the people. It will be well worth our while to examine the different aspects of an industry so full of promise. This study is made with particular reference to the conditions in Travancore, in order to compare them with those of the prawn fisheries of the Bombay Presidency, an excellent survey of which was recently conducted by Mr. H. S. Rai, under the auspices of the Bombay Natural History Society.[2]

General Considerations.

As is well known, the geography of Travancore is peculiar in having a large number of backwaters bordering the coast-line, into which open the many hill-streams from the Western Ghats. On the whole, the backwaters occupy an area of about 180 sq. miles. The chain of backwaters is separated from the sea by a narrow strip of land, composed of sand and black clay or silt, and varying from about ten miles to half a mile in width; and often the two come so close that only the sandy beach separates them. There are also frequent communications between the sea and the backwaters; either they are permanent openings allowing free admixture of salt and fresh-water, as at Neendakara and Cochin, or they are only periodical openings, allowing a flow of water from one to the other only during certain seasons of the year, as at Paravoor, Kayenculam, etc. In several places, the sand bank separating the sea and the backwater is so shallow as to allow the water to flow from the sea into the backwater during high tide. Owing to these factors and the 'brine percolation' throughout the coast, the backwaters contribute to the formation of characteristic brackish-water zones extending over a wide area in association with the low-lying lands, paddy-fields and the net-work of canals. During the South-West Monsoon, from June to September, the backwaters are in a flooded condition as the amount of water brought down by the rivers is immense and, at this time of the year, the water in them is almost fresh. The level of the water considerably falls after the North-east Monsoon, during November, when the secondary maximum period of rainfall is passed. A month hence, the water in the backwaters is distinctly brackish. The optimum conditions for the life of brackish-water animals are obtained from January to March. Though the salinity is slightly higher in the succeeding months of April and May, the conditions are unfavourable as most of the shallow regions dry up during this period.

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[1] I wish to thank Messrs. N. P. Auseph, M. R. Panikkar and G. R. Menon for much valuable information, Dr. N. P. Panikkar and Mr. Auseph for some of the photographs, and Prof. R. Gopala Aiyar for helpful suggestions.

[2] Rai, H. S., 'Shell Fisheries of the Bombay Presidency', Part II, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi (1933).

As the paddy fields have an important rôle in prawn-fishing operations, some of the relevant details about these may be included here. There are usually two periods of paddy crops, one from December to March and the other from July to October. Prawn fishing is mostly carried on in the paddy fields; hence the prawn season corresponds to the period when the fields are uncultivated. In those parts of North Travancore where this industry has developed to a certain extent, the paddy fields adjoining the backwaters, *Pokkali fields* as they are called, are cultivated only once in the year, and that during July—October, unlike the fields far off (*Punja* and *Virupu fields*) which may annually yield two paddy crops and an intervening crop of pulses and vegetables. Prawn fishing is carried on an industrial basis only in Pokkali fields that remain uncultivated for the major part of the year. In southern and middle Travancore, the December-March period is the one in practice, though in many places, where the fields are on a higher level, there may also be a supplementary crop during the Monsoon.

THE PRAWNS OF TRAVANCORE.

The prawns that inhabit the backwaters include three groups of species: (1) brackish-water species which have made the backwater more or less their permanent home; (2) marine euryhaline species which periodically migrate into the backwater; and (3) migrants from freshwater to the brackish-water. The distinction between the first and the second groups is not easy as some of the marine prawns exhibit remarkable capabilities of adjustment and have a simultaneous distribution along the sea coast as well as in the coastal backwaters. Many of them are periodical migrants that live in the brackish water during their early and juvenile stages. Much remains to be known of the migratory habits of these prawns, but it has been observed in several places that the *Penaeid* prawns, which unlike most other Decapod Crustacea hatch out at an early developmental stage as tiny pelagic nauplii, enter the backwaters as young ones, and grow there for about an year, after which they go back to the sea to breed.[1] [2] It is highly probable that the conditions in the brackish-waters at the mouths of rivers and adjoining backwaters where a large amount of organic matter is brought down, being rich in food supply, afford optimum conditions for the quick growth of young prawns. In many of these species, acclimatisation for brackish-water life is only partial. Though inhabiting the backwaters during a phase of their life history, they are apparently unable to breed and propagate there. It may be that the sexually ripe individuals and early larvae are not able to survive low salinity conditions, and that the peculiar brackish-water environment is not conducive to the proper development and dehiscence of sexual products.

Of the three groups above enumerated, the first and the second are of greater commercial importance than the third, as fresh-water prawns have only a local sale in the fresh state. They comprise the species of *Penaeus*, *Penaeopsis* and *Parapenaeopsis* among the *Penaeidae*, and of *Leander* among the *Palaemonidae*. Rai observes that the most abundant species on the Bombay coasts are *Penaeus semisulcatus* de Haan, *Penaeopsis monoceros* (Fabr.) and *Leander styliferus* (M. Edw.). The common species of the Travancore coasts are *Penaeus indicus* M. Ed., *P. carinatus* Dana, *P. semisulcatus* de Haan, *Penaeopsis monoceros* (Fabr.), *P. dobsoni* (Miers), *P. lysianassa* (De Man), and *Parapenaeopsis stylifera* (M. Ed.). It is probable that the numerous other species recorded from other parts of India are also present here since many of them have a wide distribution in the Indo-Malayan coasts.[3] The fishing season for common prawns begins with the month of November and extends to about the close of March. This statement applies only to those localities in North Travancore where prawn-fishing has assumed something of the nature of an industry.

A few observations on the biology of brackish-water prawns may be included here. Adults of *Penaeids*, especially of *P. carinatus* and *P. indicus*, are beautifully coloured. The former is a deeply pigmented species, varying in shade from bluish brown to dark grey, with dark transverse bars on the abdomen, and bright yellow markings at the bases of the pleopods. *P. indicus* is pink with numerous red patches on the body. In both these species, the deep pigmentation is observed only in fully-grown individuals. *Penaeopsis monoceros* and *P. dobsoni* are somewhat semi-transparent when alive. Specimens of all these species turn red in alcohol or formalin.

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[1] Kemp, Stanley, 'Crustacea Decapoda', in the Fauna of the Chilka Lake, *Mem. Ind. Mus.*, vol. v (1915).

[2] Dakin, W. J., 'Presidential Address', *Proc. Linn. Soc., New South Wales*, vol. lx, p. xxvii (1935).

[3] *Vide* Alcock, A., *Catalogue of the Indian Decapoda Crustacea in the Collection of the Indian Museum*, Part III, Fasc. i; Henderson, J. R., *Trans. Linn. Soc.*, vol. v, ser. ii (1893); De Man, *Siboga Expeditie*, vol. xxxix, Part I (1911); and Kemp, S., *Mem. Ind. Mus.*, vol. v, (1915).

The young prawns found in the backwaters always prefer a muddy bottom for their habitat. The question of their food habits needs much further elucidation; they appear to subsist mainly on algae at least in a few places investigated in detail by the author. Some of the larger fish found in the backwaters prey upon young prawns. Nothing is known of their moulting, but as will be shown later, their growth appears to be fairly rapid.

The freshwater prawns comprising the third group include several species of *Palaemon* which migrate into the backwaters when the latter have a low salinity. *Palaemon carcinus* Fabr. which grows to a large size is the common popular freshwater prawn of Travancore. The other species include *P. idae* Heller, *P. scabriculus* Heller, *P. sulcatus* Hend & Math., and *P. dolichodactylus* Hilgendorf.[1] Specimens of *P. carcinus* are available in large numbers in the lower reaches of most of the rivers; the season is from September to December; and an inquiry in the markets of Kottayam and other neighbouring places reveals that the largest specimens are obtained in the month of November. It is believed that the migratory individuals of *P. carcinus* are mostly the 'berried females', as judged by the proportion of sexes in fresh- and brackish-water. Henderson and Mathai[2] obtained both adult females and males from the brackish-waters near Cochin, and they state that this is the only species of *Palaemon* which they have met with in salt-water. Kemp,[3] however, has recorded several other species from brackish-water in the Chilka Lake and has made some interesting observations regarding their habits. So far as *Palaemon carcinus* is concerned, the larvae seem to be liberated in brackish-water, whence they migrate into freshwater and grow into the adult, a phenomenon quite contrary to that observed for Penaeid prawns. The migration of ripe individuals into the backwaters takes place soon after the monsoon, when the salinity is rather low.[4] According to the records of the Travancore State Fisheries Department, this migration for the liberation of the larvae occurs in October and November.[5]

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[1] Henderson, J. R. and Mathai, G., 'On certain species of *Palaemon* from South India', *Rec. Ind. Mus.*, vol. v, pp. 277-305, pls. xv-xvii (1910).

[2] *Ibid.*, pp. 277 and 282.

[3] *Op. cit.*

[4] Reviewing the conditions in the Chilka Lake, Kemp (*op. cit.*) observes:—'Only females of *Palaemon malcolmsoni* and *P. lamarrei* have been found in the lake and our observations lead us to conclude that these species visit its waters only for breeding purposes. This is also the case with the remaining species of the genus, *P. rudis*, the males of which accompany the females at this period. Adults of these three forms do not live in water as salty as that of the Bay of Bengal; but the young of *P. rudis* were found in the outer channel at the salt-water season, while adults of *P. lamarrei* are able to tolerate a considerable degree of salinity. *P. malcolmsoni* was found only in freshwater.' (*Op. cit.*, p. 264. *Vide* also p. 203.)

[5] *Report of the Agricultural and Fisheries Department, Travancore State*, for 1097 M.E., Trivandrum.

History of the Industry.

On a rough estimate, it is about sixty years since the industry began in Travancore. Originally, the prawns were collected by ordinary fishing methods which did not involve any large scale fishing, and the operations lingered for the greater part of the year. The open backwaters and not the paddy fields were the fishing areas. As will be seen from the following accounts of the methods of fishing, this condition prevails even now in many parts of Travancore, though the yield from this is negligible as compared with that from the adjoining fields. Modern improved methods of fishing have been in existence only for the past twenty years. The industry first flourished in the backwaters adjoining Parur Taluk. Owing to an increasing demand for prawns and to the high prices which dried prawns began to fetch, the industry rapidly spread to the adjoining taluks of Sherthalay and Vaikam, and to several places in the Cochin State. This became more or less the regular occupation of fishermen inhabiting the banks of the Vembanad Lake, and several industrial establishments sprang up for the collection and preservation of prawns for the market. But hardly had the industry assumed a permanent character, when the price of dried prawns fell and the enthusiasm in this direction waned with the onset of adverse trade conditions. Before discussing this aspect of the question, the methods of capture and the processes involved in geting the prawns ready for the market may be considered.

Fishing Operations.

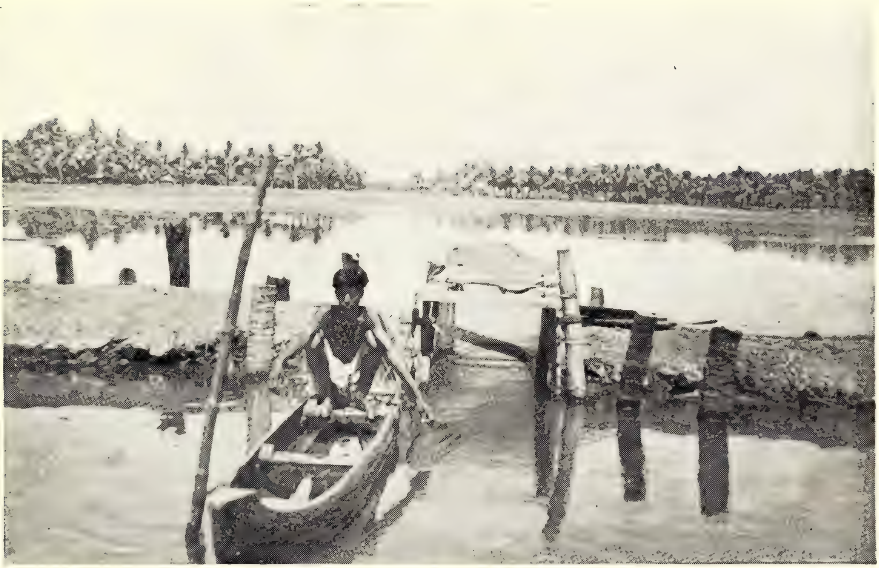
The season for the fishing operations commences in November, soon after the North-East Monsoon, with the gradual onset of brackish-water conditions in the backwaters. In Travancore, the brackish-water prawn fisheries are best exploited in the Taluks of Parur, Vaikam and Sherthalay. Of these, the produce from the first mentioned place is by far the most important and contributes to about fifty per cent of the total annual produce of the state. In the Cochin state, the important prawn-fishing centres are the villages adjoining the Narakkal canal.

The conditions in the fisheries of the Parur taluk may be taken as more or less typical. Here, the paddy fields closely adjoin the backwaters, and they are on a slightly higher level. As pointed out before, the paddy crop corresponds to a period when the water is fresh. The harvest being over by about the end of September, the fields are free, and for about a month or two the water from the backwaters is allowed to get in and out freely. The flooding caused by the October-November rains often keeps the paddy-fields in direct communication with the backwaters and associated canal systems. The fields contain a lot of organic matter like hay and the November floods bring down plenty of organic as well as inorganic materials. The bottom of the fields remains muddy owing to the loose consistency of the characteristic black soil. The activities of the prawn fisheries begin with the lowering of the water-level after the monsoon. The bunds surrounding the fields are strengthened and the communications between the canals and the fields are restricted to a few sluice gates, usually one for each field (Plate II, fig. 1). These gates are carefully guarded by elaborate wooden frameworks, and with the proper manipulation of a series of adjustable planks, the water level in the fields is carefully regulated. The rains having practically ceased, there is no appreciable flow in the canal systems, and the tidal effects are hence markedly felt. The water becomes increasingly brackish. The tidal range is subject to some amount of variation from place to place; it is maximum in places where the shallow waters have been re-claimed into paddy fields which, after reclamation, are cut off from the backwater, leaving only narrow canals amidst them. At Paravoor and Kayenculam, the range is two and a half feet, while in the canals associated with the prawn-fishing centres of Nedungad, Varapuzha, Ezhikara and Chathanad, the tidal range is slightly above the former, and the onset of ebb or flow is attended by a powerful flow of water.

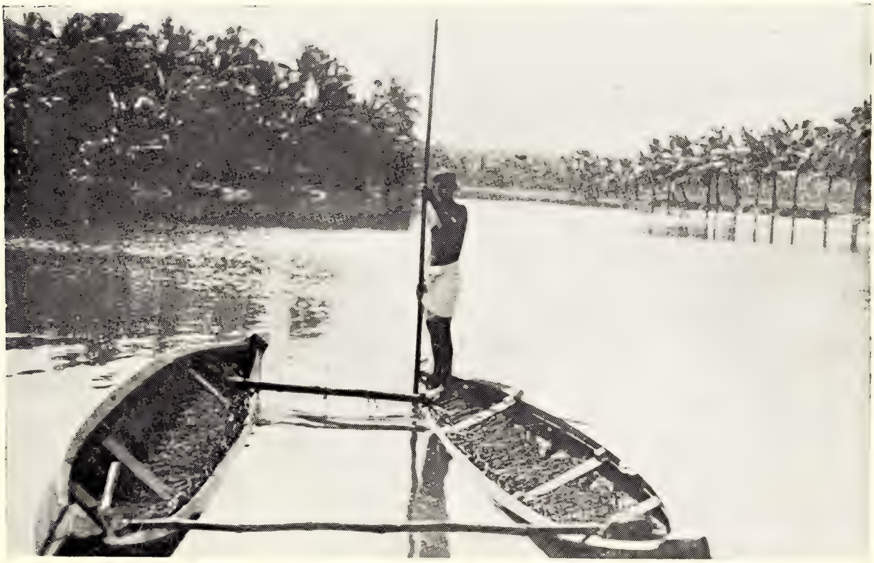
The tidal action is of great advantage to the fisherman. He keeps open the sluice gates during high tide and allows brackish-water to get in freely into the paddy-fields. The prawns, which abound in the backwaters at this period, get into the paddy-fields along with the inflowing water. The gates are closed with the onset of the flow tide. This process is carried on regularly for about a month, whereby the number of young prawns in the paddy-fields is gradually increased. To effect a proper change in the water of the fields, the gates are opened about thrice a week during flow tide and water is allowed to drain off to a certain extent. But to prevent the young prawns from escaping, the gate is guarded by a special contrivance, which consists of a number of flexible twigs of wood joined together to form a lattice-work.

The post-larval stages of *Penaeids* enter the backwaters wherever the latter are in communication with the sea. They are then beautifully transparent and usually measure 1-2 cm. in length. As we know nothing of the breeding habits of marine prawns, it is not possible to ascertain definitely the commencement and duration of the migration of young individuals into the backwaters. Young specimens ranging from 3 to 5 cm. in length are found in the backwaters during many months of the year, especially from August to December. This observation, considered along with the well known fact that most *Penaeids* are not known to breed in brackish-water, would suggest that several batches of young individuals from the sea enter the backwaters. Their rate of growth is astonishingly rapid. Nothing definite is known of the conditions favourable or otherwise to their growth. The prawns entering the fields vary in length from 5 to 8 cm.

The actual fishing of these prawns takes place only after two or three months from the time they have entered into the fields. There is, however, considerable variation from place to place in the period allowed to elapse between the time of entry of the prawns and the commencement of fishing. Size is the main

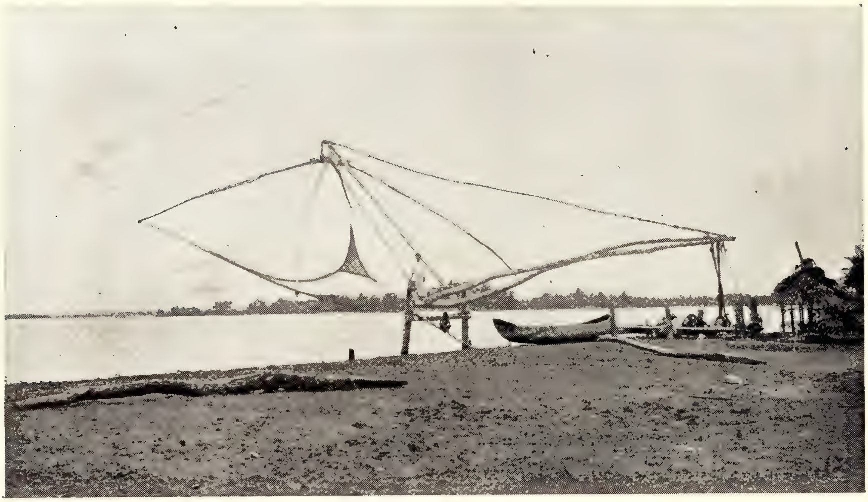


1. Bund with sluice gate.

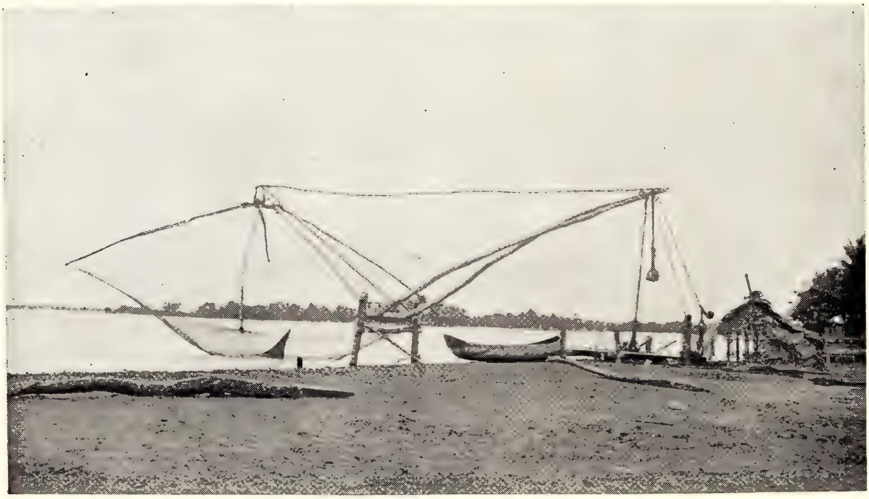


2. Two boats tied together to support the net between them.

FISHING WITH CHINESE NETS.



1. The Net raised.



2. The Net lowered.

deciding factor; those usually fished from the paddy-fields are 8-12 cms. long; and the largest ones, obtained after some months since the beginning of fishing operations, are some 13 cms. long, which is about the maximum size to which *Penaeids* grow in brackish-water. With the increase in size of prawns in the fields, the salinity of the water also increases as the rains gradually diminish. This has given rise to a curious belief among the fisher-folk that the prawns really grow by absorbing more and more of salt from the water.

The commencement of the regular course of fishing is an exciting event for the fishermen. The first catch is usually made during the *Thiruvathira* festival which comes off at the end of December or at the beginning of January. A large conical net is fitted to the outside of the sluice gate, the wide portion surrounding the gate. This net is a strong one, with close meshes varying from ¼ to ½ inch and very much resembles the *bokshi* of Sindh coasts described by Rai. When the level of water outside the fields begins to fall with the onset of flow tide, the planks retaining the higher level of water in the fields are removed one by one, allowing the water to force its way outside. The numerous prawns that swim out of the fields are caught in the conical nets; they accumulate in the narrow side of the cone. Usually one man waits here and periodically removes the prawns, an easy process as the narrow side of the cone is adjustable.

Fishing is usually done at night and the period corresponds every day to the onset of flow tide; hence the successive periods change according to the phases of the moon. A powerful light is often placed in the sluice gate to lure the prawns to the net.

Fishing in backwaters and canals is also prevalent in addition to that of the paddy fields. Two characteristic methods of open backwater fishing are worthy of note. One is designed to capture prawns swimming in shoals. Two country boats are tied together as shown in the photograph (Plate II, Fig. 2), with the intervening space supporting large nets which trap the prawns that try to swim through. These boats are stationed in key positions frequented by the crustaceans.

The next method is an extremely picturesque one which no one who has visited these backwaters can forget. In almost every edge of the backwaters, a large stellar framework of wood may be seen, supporting large fishing nets locally called the *cheena valai* or *kamba valai.* This peculiar fishing implement is believed to be of Chinese origin, and it is considered as a remnant of ancient trade relations that existed between China and the West coast of India. Fishing with Chinese nets is not mainly intended for prawns; but the latter are caught in large numbers during their season of abundance. The method of fishing with the Chinese nets is an exceedingly simple process and will be clear from the accompanying photographs (Plate III, Figs. 1 and 2). Fishing is usually done only at night, and a lantern is hung to the wooden frame-work when the net is lowered into the water, so as to lure the prawns and fish to the net,

CURING OF PRAWNS.

Two industrial processes are in vogue for the preparation of prawns for the market: Sun-drying and boiling. The first process is the more common on the Bombay coast, while the latter method followed by drying is the more popular one in Malabar. On the West Coast, boiling is employed in all places where the produce is considerable and sufficient for export to other places. Sun-drying without boiling is employed in the preparation of prawns in those parts of Travancore where the produce is much less than in places like Parur Taluk; they form an article of cottage industry catering only to local demands. In both methods of preparation, the operations should be begun soon after the capture of the prawns, as putrefaction sets in rapidly. Usually, not more than three hours is allowed between the time of capture and the commencement of the first process. Boiling has the advantage of being partially independent of weather conditions. For boiling, the prawns are first put into wide flat copper vessels in a wet state, and often a little extra water is added to prevent them from getting roasted. They are boiled for about half an hour; and when they assume a dark reddish-brown colour, they are removed from the vessels and dried in the sun for several days. It should be noted here that in many places, salt is not generally added when the prawns are cured. The belief among those engaged in the industry is that the salt present in the brackish-water is sufficient for the purpose, and hence, salting is tabooed as being a deceitful measure to increase the weight of dried prawns. Rai observes that the fishermen of the Sindh coasts add a little salt to the fresh prawns when they are boiled. It appears that improper curing is the chief reason why the dried prawns from the West Coast do not remain long in a good condition.

The next process is to get rid of the shells, 'prawn-skins' as they are often called, which include the carapace, rostrum and limbs. For this purpose, large jute sacks are taken and filled with dried prawns to about a fourth of their capacities, after which they are closed and tied up. Women are especially in charge of this part of the work. They swing round each sack and hit it hard on a block of wood until the carapace and limbs fall off, leaving the fleshy parts intact. The latter are removed and sorted out separately; they are popularly called *prawn kernels*.[1] The kernels are once again dried; the pieces of shell adhering to them are carefully removed by hand; and finally, they are packed up in jute bags for export.

The discarded 'skins' are heaped up separately. They are of much use to the agriculturist as they form an important source of manure, especially for coconut palms. Their value as food for poultry has been realized only by a few. Large quantities of 'prawn-skin' used to be exported to Germany and other European countries; but of late, the exports have fallen considerably. The present market rate for prawn-skin varies from Rs. 8 to Rs. 10 per candy.

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[1] *Chemmeen-parippu* in Malayalam.

MARKETING OF PRAWNS.

Dried prawns do not command a wide market in India at present. The only place where they are in demand is the Bombay Presidency, where a portion of the local produce caters to the local demands. About half the produce of the Sindh and Bombay coasts is consumed locally, while the rest is exported to different places outside India, mainly to the Far East. The best markets for Indian dried prawns are Rangoon, Singapore, Colombo, Hongkong and Mauritius. As only fresh prawns are popular among people of the West Coast, especially in the important prawn-fishing centres, almost the whole of the produce that is boiled and dried is exported. From statistics available, Rangoon has been the best purchaser for many years. The dealers in Travancore send their supplies to businessmen in Rangoon, who dispose off the material. The price of dried 'prawn-kernels' ranged from Rs. 150 to 300 per candy before the present economic crisis; in some years (1929-30) the figure rose so high as Rs. 350 in the wholesale exporting markets of Cochin and Alleppey. Like all other commodities, the prices have fallen during the past few years; but recently, there has been considerable improvement, the figures having steadily risen from the lowest index of Rs. 50 per candy in 1933 to about Rs. 150 at the time of writing.

IMPROVEMENT OF THE INDUSTRY.

In discussing the possibilities of improving the prawn industry on the West Coast, we have to examine critically the factors which have been responsible for the present fall in prices. As pointed out before, the general decline in price levels consequent on the current trade slump has considerably affected the commerce of prawns, but the fall in this instance has been mainly due to the numerous handicaps under which the present prawn dealer has to transact his business. First of all, there is no scheme of planned production. Secondly, the method of preparation of prawns for the market is very imperfect. Dried prawns from the West Coast are fit for human consumption only for about four months from the time they are dried and packed. In this respect, the West Coast producer is unable to compete with his Bombay competitors who sell goods of a better quality. The markets where prawns from the West Coast are in demand are rather few at the present time; in these few places, the goods are sold by middlemen. For example, the producers in Cochin and Travancore export their goods to brokers in Rangoon, who sell them to the local dealers under the current market rate, and often take a very high percentage of discount for their services. There have been occasions when about 50 per cent of the net proceeds have been discounted by these agents; and further, prohibitive charges are made for retaining the unsold goods in the godowns. In spite of all these handicaps, the industry has slowly progressed since the capital required is so small as compared to the profit. Whatever the producer gets from prawns is a decent income which compares very favourably with what he gets from paddy crops for which his fields are primarily intended.

The increase in the annual produce of prawns from the West coast, depends upon the chances of spreading the industry to other places where prawn-fishing is not extensively carried on and the possibilities of increased output from those areas that are now being exploited. It was pointed out before that in Travancore the best yield is from Parur Taluk. The particular advantage of this place lies in the low level of the paddy fields, the high salinity of the backwaters, and the tidal phenomena. Similar facilities are equally enjoyed by certain other places in Travancore, such as the fields adjoining the backwaters of Kayenculam and the lake of Ashtamudi near Quilon. The species of prawns (both the brackish-water as well as the migratory forms) collected from Parur are obtained at those places also. But here, the methods of paddy cultivation are not quite suited to the conversion of these fields into 'prawn-yards'. As an experimental measure, it would be desirable to attempt finding out if the methods of cultivation followed at Parur may be copied here, with a view to introducing an intervening prawn season. It should be mentioned, however, that in such a change the factors involved are many. Every possible means of effecting suitable changes in periods of cultivation should be explored so as to ensure a regular output of prawns in addition to paddy. If successful, this would be of considerable advantage to the owners of paddy fields, as the income from paddy has been steadily on the decline for the past so many years, and any supplementary income would be of much benefit to them.

For increasing the output of prawns from those localities where the industry already exists, we must know much more about the feeding, breeding, and migratory habits of the prawns in question, about which so little is known at the present day. It should also be found out if the continuance of the paddy crop in the fields is of advantage or of disadvantage to the industry. It is reasonable to expect better produce in certain fields near the sea if they are converted into permanent prawn-yards more or less on the lines of the prawn-fisheries of the Sindh coasts.

Improvements in methods of preservation, whereby the dried prawn kernels could be kept properly for longer periods, would be highly useful as it would enable export to far off places. A constant supply throughout the year could also be ensured in this way. There may also be an increased demand for dried prawns from inland towns of India. But in popularising prawns in Indian markets, methods which will enable their being sold fresh are likely to meet with better results than those intended for the distribution of dried material. Small quantities of fresh prawns are at present sent from important prawn fishing centres on the West Coast to Madras, Trichinopoly and other places. They are packed along with ice, in large deal-wood boxes, and sent by the Railway; and in the markets of the above mentioned places, iced-prawns are soon sold out. In the present state of the industry, it is doubtful if large-scale brine-freezing and allied methods for the distribution of fresh prawns would meet with immediate success in India; but this may become beneficial with increased output and with increased demand for fresh material. With proper organization, the producers could have their own establishments in the best selling centres and the loss through the middlemen could thus be eliminated. The Government trade agencies could do much to popularise the product. It would thus be seen that for the improvement of the industry, there must be planned production, improved marketing facilities and co-operative enterprise amongst those engaged in the industry. Biological research has much to contribute towards the success of the industry by providing accurate and detailed information on the bionomics and life-histories of prawns of economic importance, which will eventually help in the proper exploitation of the available fishery resources. Much important statistical data are also badly needed. In course of time, protective legislation may be necessary to prevent over-fishing and wastage which are detrimental to any fishing industry. With all these factors attended to, it is not unreasonable to anticipate the development of a very important and lucrative industry from organized prawn culture and prawn fishing in the West Coast.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1.—An ovigerous female of *Palaemon sp.* (about natural size). l_2, the second thoracic leg which grows to an enormous size in the male; *ov*, developing eggs.

PLATE II.

Fig. 1.—The sluice gate between the paddy-field and the adjoining canal. The fisherman on the boat is holding the conical net tied to the gate. Photograph taken from a locality near Parur (North Travancore).

Fig. 2.—Open fishing in the backwater, with two boats fastened together, intended to catch prawns swimming in shoals. Photograph from the same locality as the above.

PLATE III.

Figs. 1 and 2.—Two views of the characteristic Chinese nets in the backwaters of Travancore and Cochin. In fig. 1 the net is in the raised position, while in the second it is partly lowered.

NOTES ON MURREE BIRDS.

BY

REV. E. A. STORRS FOX.

The following notes are chiefly by way of a commentary on previous notes by Lt.-Col. R. H. Rattray which appeared in vol. xvi of the *Journal*, and those by Major H. A. F. Magrath which were published in vol. xix. These present notes do not however include the birds of the Galis, unless specially mentioned, but only those found on the Murree hill itself. I was stationed myself in Murree during the years 1932 to 1935 including one complete winter and parts of two other winters, and have therefore had opportunities, such as do not appear to have been enjoyed by the two former writers, of observing the Murree bird life at all seasons of the year.

The following observations are intended to supplement those already made by the two writers above-mentioned.

Dendrocitta rufa. The Indian Tree Pie. This bird is not mentioned either by Col. Rattray or Major Magrath. I have never seen one as high as Murree itself, but have noticed it several times near Company Bagh (4,500 ft.) on the road down to Tret.

Garrulus lanceolatus. The Black-throated Jay. Very much in evidence all over the station during the winter (and rather less so in summer), but I have never seen it going about in flocks as e.g. at Mussoorie.

Machlolophus xanthogenys. The Yellow-cheeked Tit. I should not call this a rare bird, as Col. Rattray does, but it is certainly not as common as the other four Murree tits. Nor is it really shy and I have often seen it on the Mall and in my own compound within a few feet of the house.

Lophophanes melanolophus. The Crested Black Tit. The commonest of the Murree tits in winter but much less often seen in summer.

Lioptila capistrata. The Black-headed Sibia. Common in winter but less so in summer.

Pteruthius erythropterus. The Red-winged Shrike Tit. Fairly common in winter, but I have not seen it during the summer months.

Cephalopyrus flammiceps. The Fire-cap. I have only seen this bird at Murree in April, so conclude it was then on the way up to higher levels, as Col. Rattray mentions it as being quite common on the high hills near the Galis.

Molpastes intermedius. The Punjab Red-vented Bulbul. I saw a few of these birds on a number of occasions in January 1933 when the snow was lying thick. What made them come up to Murree at this particular time of year I cannot think. I have never seen them at any other season.

Molpastes leucogenys. The White-cheeked Bulbul. I have never seen these birds on the Murree hill in summer higher than about 5,500 ft. By the end of November they begin to come into Murree, and after the snow has fallen they become very abundant (attracted I suppose by the very plentiful supply of berries). As the spring advances they retire downhill again. Major Magrath says that he saw a pair in Murree on April 29th, but this is rather late for them.

Sitta kashmirensis. Brook's Nuthatch. Neither Col. Rattray nor Major Magrath mention this bird. It is rare in Murree, but I have occasionally seen one during the summer.

Sitta leucopsis. The White-cheeked Nuthatch. Like Major Magrath, and unlike Col. Rattray, I have not found this bird uncommon at times. I am not sure however that it breeds in Murree and am rather inclined to think that it does not. About the middle of October it becomes rather plentiful for a few weeks and after that scarce again, which leads me to suppose that Murree is only being made a temporary halting place. I have however seen specimens in mid-winter and as late as June 26th, but none after that date until the following October.

Dicrurus ater. The Black Drongo. This bird seems common in summer, though perhaps not as common as the Ashy Drongo.

Anorthura neglecta. The Kashmir Wren. Common in winter; November 11th is the earliest date I have seen it and none later than March 15th.

Regulus cristatus. The Goldcrest. Fairly common between the beginning of December and the middle of February, but I have not noticed it during the summer.

Cryptolopha xanthoschista. Hodgson's Grey-headed Flycatcher-warbler. Like Col. Rattray, I have not found this bird common. Major Magrath notes it as being very common in April. I have certainly seen it most often about then; I have also noticed it at the end of December.

Campophaga melanoschista. The Dark Grey Cuckoo-shrike. Comparatively plentiful in the summer of 1935, but I only saw one in 1933 and none in 1934.

Oriolus kundoo. The Indian Oriole. Very common in summer. First makes itself evident towards the end of April.

Aethiopsar fuscus. The Jungle Myna. Col. Rattray seems to have found it common. My own experience has been the opposite, as I only saw two pairs nesting in 1933 and one pair in 1934, though a few more in 1935.

Hemichelidon sibirica. The Sooty Flycatcher. Colonel Rattray notes these as very rare; Major Magrath found them common till the middle of May. Personally I remember none during 1933 and 1934, but saw quite a number between the end of April and the beginning of August during 1935.

Terpsiphone paradisi. The Indian Paradise Flycatcher. Major Magrath mentions a single specimen. I have never seen one in Murree, but have heard of them being seen below Sunny Bank and near the Brewery.

Rhipidura albifrontata. The White-browed Fantail Flycatcher. I have seen this bird in summer above the Brewery and below the Lawrence College, but I believe it to be rare.

Pratincola maura. The Indian Bush-Chat. Quite common after the middle of March up to 7,000 ft.

Oreicola ferrea. The Dark-grey Bush-Chat. Abundant in summer. Begins to arrive about the middle of March.

Enicurus maculatus. The Western Spotted Forktail. Not common on the Murree hill; I only saw two or three pairs in 1933 and 1935, and only one pair I think in 1934.

Chaimarrornis leucocephalus. The White-capped Redstart. I have never seen this bird in Murree itself, but I noticed one at Company Bagh (4,500 ft.) in January 1933, and another at Chrrapani (4,000 ft.) in January 1935.

Ruticilla frontalis. The Blue-fronted Redstart. Fairly common in winter; not seen before November 21st or later than April 30th.

Ruticil'a erythronota Eversmann's Redstart. Fairly common during winter; first seen on November 28th.

Ianthia rufilata. The Red-flanked Bush Robin. Fairly common from October to April.

Adelura cæruleicephala. The Blue-headed Robin. Begins to arrive about the end of October (first seen on October 26th), and is extremely abundant throughout the winter. Last seen on March 22nd.

Merula castanea. The Grey-headed Ouzel. I have not noticed this bird in Murree during the summer, but it is fairly common in winter from the beginning of November.

Merula atrigularis. The Black-throated Ouzel. Begins to arrive in Murree in considerable numbers in November (first seen on November 21st), and thereafter becomes very abundant, especially after the snow has begun to lie, during which period no bird in Murree is in greater evidence. With the arrival of spring the bird departs, but I have seen a few at any rate as late as April 24th. Possibly some remain into the summer.

Pyrrhula aurantiaca. The Orange Bullfinch. Not very common, but occasionally seen during mid-winter, and as late as March 16th in 1935.

Propasser grandis. The Red-mantled Rose Finch. Common from the middle of November till the end of March.

Carduelis caniceps. The Himalayan Gold Finch. Not very common, but seen sometimes in January when the snow is lying deep.

Callacanthis burtoni. The Red-browed Finch. I once saw a pair in January 1933, but none since.

Metoponia pusilla. The Gold-fronted Finch. This bird is seen occasionally in small flocks in mid-winter.

Hypacanthis spinoides. The Himalayan Greenfinch. Common from the latter part of the summer onwards. The ripening of the sunflower-seeds always seems to be the signal for a great invasion by flocks of these birds.

Emberiza stewarti. The White-capped Bunting. I have not found this bird as common as Col. Rattray seems to indicate, but I have seen it in Murree from April onwards.

Chelidon urbica. The Martin. Col. Rattray speaks of the Kashmir Martin not being found in Murree, while Major Magrath mentions this same bird (*Chelidon kashmiriensis*) breeding in considerable numbers in the verandahs of bungalows near the water tanks; he also thinks that the European House Martin occurs in some of these colonies. Nowadays there is a large colony of Martins breeding every year at S. Denys' School (near the water tanks), and I have had plenty of opportunities of studying them closely. Although I have not actually killed a specimen, I have watched them so often through my glasses on their nests only a few yards away as to be convinced that all these birds are urbica and not kashmiriensis.

Motacilla personata. The Masked Wagtail. One or two specimens seen in March.

Motacilla hodgsoni. Hodgson's Pied Wagtail. A pair once seen in September near Lower Topa.

Motacilla melanope. The Grey Wagtail. I have seen a number passing through in April and early May, and again at the end of August. One pair (presumably the same each trip) always halts in my garden for a week or so both on the upward and downward journey.

Anthus trivialis. The Tree Pipit. I have seen a few specimens late in April and early in May, and once a pair at Patriata in the first week in April.

Gecinus occipitalis. The Black-naped Green Woodpecker. Colonel Rattray seems to have found this bird fairly common. I never came across any till October 1935 when I saw two pairs.

Hypopicus hyperythrus. The Rufous-bellied Pied Woodpecker. Rare; I only saw two during the summer of 1933 and one in summer of 1934; commoner in 1935.

Dendrocopus auriceps. The Brown-fronted Pied Woodpecker. Much more common in winter than in summer. but never so abundant as Gecinus squamatus or Dendrocopus himalayensis (the two commonest Woodpeckers in Murree).

Picumnus innominatus. The Speckled Piculet. I have once seen this bird in November 1934.

Cyanops asiatica. The Blue-throated Barbet. Common in summer after the beginning of May, though never as common as the Great Himalayan Barbet (which is abundant all the year round). I once saw this bird on January 2nd sitting on a tree in the snow by the side of the Mall, but this is the only specimen I have seen during the winter months.

Upupa epops. The European Hoopoe. Common after the middle of March.

Cypselus melba. The Alpine Swift. I have only thrice been able to identify this bird for certain when I saw a large number on November 7th, 1934, hawking above the old Terrace Hotel, and again in July and August 1935.

Cuculus canorus. The Cuckoo. First heard on April 15th; very common thereafter, and also very tame.

Cuculus saturatus. The Himalayan Cuckoo. First heard on April 20th. Not quite so common as canorus, and rather more bashful as a rule.

Palæornis schisticeps. The Slaty-headed Paroquet. Common in summer, though not I think as plentiful as in some hill stations. I have rarely seen it in winter, but once remember noticing a large and very dejected looking flock sitting on a bare tree near the Mall in a snowstorm during January.

Glaucidium cuculoides. The Large Barred Owlet. I have seen this bird but do not think it is common.

Glaucidium brodiei. The Collared Pigmy Owlet. From my own observations this bird seems much commoner than the last-named.

Gypaëtus barbatus. The Lammergeyer. Neither Col. Rattray nor Major Magrath mention this bird, but it is very common in Murree.

Buteo ferox. The Long-legged Buzzard. I have seen a good number of (what I take to be) these birds.

Astur palumbarius. The Goshawk. I have seen this bird once or twice in winter.

Sphenocercus sphenurus. The Kokla Green Pigeon. I have seen it in Murree, but should not have thought it common there now.

Palumbus casiotis. The Eastern Wood-Pigeon. Seen in winter in flocks.

Turtur ferrago. The Indian Turtle-Dove. Col. Rattray found it common in summer, while Major Magrath apparently only noticed it migrating at the end of April. My own experience agrees with the former.

Gennæus albicristatus. The White-crested Kalij Pheasant. Col. Rattray did not think this bird common in 1905. I have only seen (and eaten) it dead in Murree, and believe that it has probably been more or less exterminated by now in the immediate vicinity of the station.

Caccabis chucar. The Chukor. I have not seen this bird wild in Murree, and think that its numbers too have probably been reduced to a negligible quantity since Col. Rattray wrote.

Hydrophasianus chirurgus. The Pheasant-tailed Jacana. I saw one of these birds on the water tanks on May 31st 1933, and understood that they sometimes migrate by way of the Jhelum valley; but it cannot be often that a specimen finds itself on the top of the Murree hill.

ON TWO NEW SPECIES OF *ANTHOCEROS* LINN. 1753 FROM SOUTHERN SHAN STATES, BURMA, WITH A COMPARATIVE CHART OF THE DIOECIOUS DARK SPORED SPECIES OF THE GENUS.

BY

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The material for this paper was obtained from the Southern Shan States, Burma.

Anthoceros meggitti sp.n.[1] (Pl. I, Figs. 1-5).

Locality.—Kalaw.

Dioecious. Thallus 12-15 × 3-8, slightly depressed in the centre, the margin lobed. Surface cells 0.04-0.06 × 0.03-0.04, each with a large chloroplast; cavernous. Involucre 6-7 long × 0.5 broad, cylindrical, slightly narrowed at the nearly truncate apex. Capsule 46-55 long × 0.5 broad, dark brown; stomata 0.075-0.09 × 0.042-0.05. Spores 0.04-0.045 black, thickly granular-papillate; pseudoelators 1-5 celled, dark brown, thin walled. Male plants smaller than the female. Antheridia 0.17 × 0.105, in groups of many in receptacles with a denticulate margin, scattered over the dorsal surface of the thallus.

A. curnowii Stephani 1916, *A. koshyii* Khanna 1936, *A. minutus* Mitten. *A. miyakeanus* Schiffner 1899, are separated from the present form by the solid structure of their thallus and their shorter involucres; *A. chabensis* Kashyap 1917, *A. cucullatus* Stephani 1916, *A. faurianus* Stephani 1916, *A. lamellatus* Stephani 1916, *A. myriandroecius* Stephani 1916, *A. parkinsonii* Khanna 1933, *A. pichinchesis* Stephani and *A. telaganus* Stephani 1916, differ from the present form in having smaller involucres and in the size of their capsules; *A. chevalieri* Stephani 1923 and *A. erectus* Kashyap 1915 are distinguished from the present type by their longer capsules; *A. weistii* Khanna 1932 differs from the present form in the size of the plant and stouter involucre; *A. ferdianus* Stephani 1916 differs from the present form in having bigger capsule and bigger spores. It is therefore necessary to create a new species for which I propose the name *Anthoceros meggitti* sp.n.

Anthoceros burmani sp.n. (Pl. II, Figs. 6-10).

Locality.—Taunggyi.

Dioecious. Thallus 12-17 × 7-8, prostrate, with irregularly divided segments; segments linear or oblong, channelled, with the margins ascending and sinuate. Surface cells 0.050-0.065 × 0.02-0.04; cavernous. Involucre 6-8 long × 1.3-1.5 broad, cylindrical, narrowed towards the apex, the mouth lobulate. Capsule 12-15 long × 0.3 broad; stomata 0.06 × 0.04. Spores 0.058, black with numerous spines; pseudoelators thick walled, dark brown, 1-4 celled. Male plants much smaller than the female. Antheridia in groups of 12 or less scattered over the dorsal surface of the thallus.

The longer involucre and the shorter capsule separates the present form from *A. chambensis* Kashyap 1917, *A. chevalieri* Stephani 1923, *A. cucullatus* Stephani 1916, *A. erectus* Kashyap 1915, *A. faurianus* Stephani 1916, *A. lamellatus* Stephani 1916, *A. myriandroecius* Stephani 1916, *A. pichinchesis* Stephani and *A. telaganus* Stephani 1916; the cavernous structure of the thallus from *A. curnowii* Stephani 1916, *A. koshyii* Khanna 1936, *A. minutus* Mitten and

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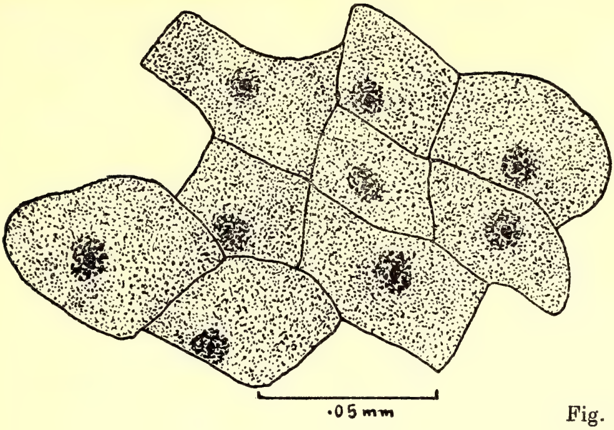
[1] All measurements are in millimetres.



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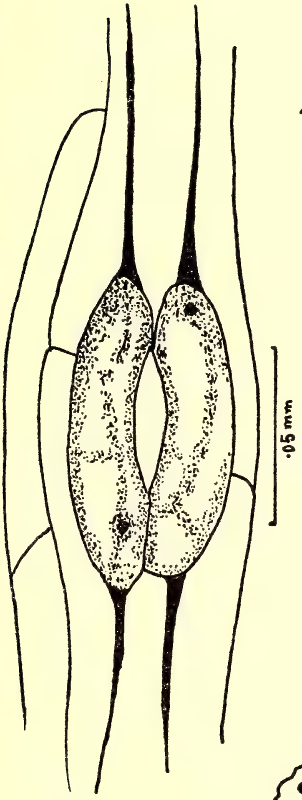

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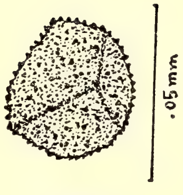

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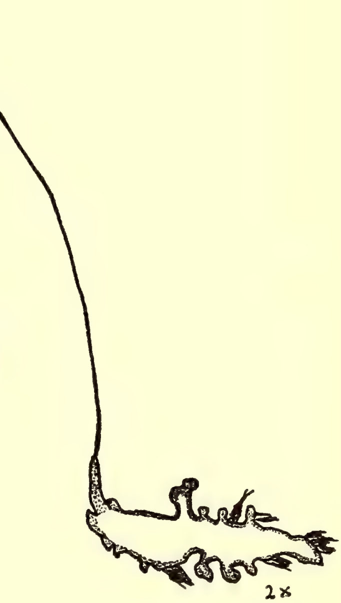


Fig. 1.

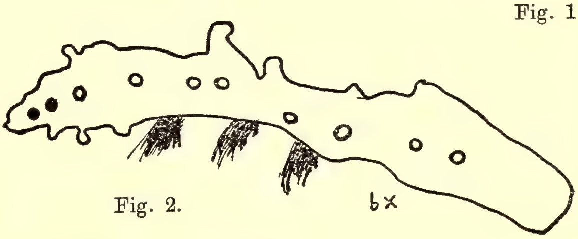
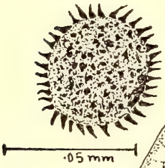


Fig. 2.

Anthoceros meggitti sp.n.

For explanation see end of text.

Fig. 10.



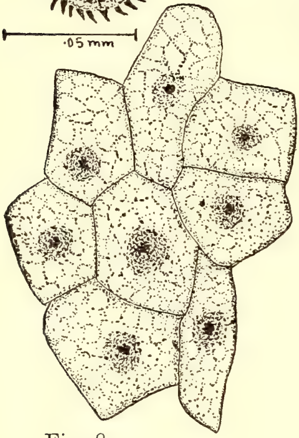


Fig. 8.

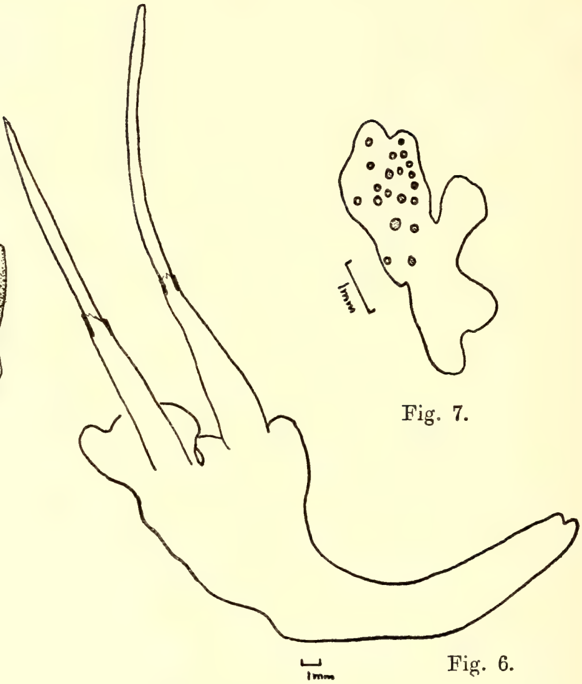


Fig. 7.

Fig. 6.

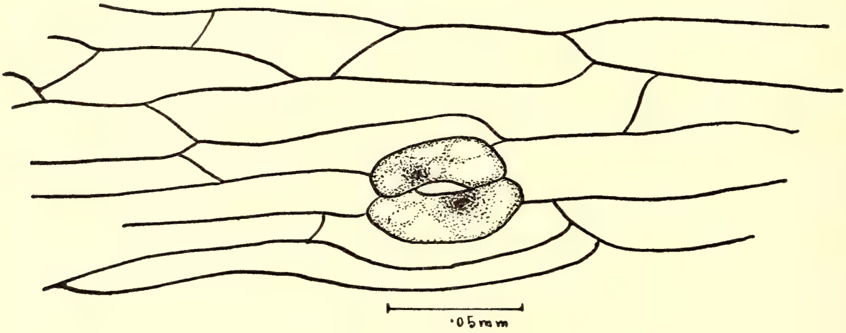


Fig. 9.

Anthoceros burmani sp.n.

For explanation see end of text.

Anthoceros Linn. 1753 (Diœcious and dark spored species)

	Thallus	Size	Involucre	Capsule	Spores	Distribution
burmani Khanna sp. n ...	cav.	12–17 × 7–8	6–8 × 1·3–1·5	12–15 × 0·3	·058 sp.	Burma : Kalaw.
chambensis Kashyap 1917...	cav.	...	2·5	25	·04 – ·048	India : Chamba Valley, Punjab, Sialkot.
chevalieri Stephani 1923 ...	cav.	20	...	20	·045 pap.	Africa centralis.
cucullatus Stephani 1916 ...	cav.	15	2	50	·036 asp.	Guadeloupe.
curnowii Stephani 1916 ...	solid]	15	...	...	...	Britain : Cornwall.
erectus Kashyap 1915 ...	cav.	10	...	30	·03 – ·04	India : Outer and Kumaon Himalayas, Madras ; Travancore.
faurianus Stephani 1916 ...	cav.	10	3	30	·036 hisp.	Japan.
ferdinandi Taylor ...	cav.	10	6	60	·045 echin.]	Australia : Port Denison.
koshyii Khanna ...	solid]	5–12	2·8–3·6 × ·8	12–15 × 1·0–1·5	.046 – ·065 pap.]	India : Trivandrum.
lamellatus Stephani 1916 ...	cav.	5	4	20	·045 hisp.	Brasilia : Rio de Janeiro.
meggitti Khanna sp. n. ...	cav.	12–17 × 7–8	6–7 × ·9	46–55 × ·5	·04 gr. pap.]	Burma : Taunggyi.
minutus Mitten ...	solid]	20	...	...	...	Africa.
miyakeanus Schiffner 1899...	solid]	15 × 5	1	10	...	Japan.
myriandroecius Stephani 1916 ...	cav.	12	2	30	·054 pap.	Africa.
parkinsonii Khanna 1933 ...	cav.	5–14	1·65–2·8	13·0–30·0 × ·28–·45	·041 – ·052	Burma : Maymyo.
pichinchesis Stephani ...	cav.	...	3	30	·05 asp.	Andes, in Monte Pichincha
telaganus Stephani 1916 ...	cav.	5	5	20	·045 pap.	Java.
weistii Khanna 1932 ...	cav.	30–50	6–10 × 1·5–2·5	30–66	·038–0·53	Burma : Rangoon.

asp. = asperulous
cav. = cavernous.
echin. = echinulate.
gr. pap. = granular papillate.
hisp. = hispid.
pap. = papillate.
sp. = spinous.

A. miyakeanus Schiffner 1899; shorter capsule and bigger spores from *A. ferdinandi* Taylor, *A. meggitti* sp.n. and *A. weistii* Khanna 1932; longer involucre and bigger spores from *A. parkinsonii* Khanna 1933. It is, therefore, necessary to create a new species for which I propose the name *Anthoceros burmani* sp.n.

In the table above the differences between the present forms and the previously described dioecious dark spored species are tabulated.

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REFERENCE FOR THE TEXT-FIGURES.

Anthoceros meggitti sp.n.: Fig. 1.—Female plant; Fig. 2.—male plant; Fig. 3.—dorsal epidermal cells; Fig. 4.—stoma, Fig. 5.—spore; *Anthoceros burmani* sp.n.: Fig. 6.—female plant; Fig. 7.—male plant; Fig. 8.—dorsal epidermal cells; Fig. 9.—stoma; Fig. 10.—spore.

THE MEDICINAL SPIDERWORTS OF INDIA.

BY

J. F. CAIUS, S.J., F.L.S.

The COMMELINACEAE are perennial herbs generally distributed in the Tropics and Subtropics, a few in China and Japan, the Southern United States and in Australia. The family includes 30 genera with about 400 species.

Many species possess an abundant mucilage, which is alimentary after being cooked; and the tuberous rhizomes of some contain, besides mucilage, starch, which adds to their nutritive qualities. The species credited with medicinal properties belong to 8 genera:—ANEILEMA (Tropics); COMMELINA (Tropics and Subtropics); CYANOTIS (Tropical Asia and Africa); FLOSCOPA (Tropics); PALISOTA (Tropical Africa); POLLIA (Old World Tropics and Subtropics); TINANTIA (Mexico to Brazil); TRADESCANTIA (Tropical and North America).

The medicinal Spiderworts of India belong to 4 genera:—ANEILEMA, COMMELINA, CYANOTIS, FLOSCOPA.

I. Capsule loculicidal. Stamens 3, perfect; with 1-3 staminodes.
  1. Cymes solitary, included in a spathe. Ovary 3-celled; cells, 1-2 ovuled ... ... COMMELINA.
  2. Cymes naked, panicled, rarely in a spathe ... ANEILEMA.

II. Capsule loculicidal. Stamens 6, perfect.
  1. Cymes from imbricating bracts, scorpioid, or 1-2-few-flowered. Corolla tubular below ... ... CYANOTIS.
  2. Flowers panicled. Stem erect ... ... FLOSCOPA.

ANEILEMA.

This genus numbers 85 species, tropical and subtropical, chiefly Asiatic.

In the Gold Coast Colony the leaves of *A. beninense* Kunth. and *A. ovato oblongum* P. Beauv. are used in enemas to cure constipation.

Four Indian species are used medicinally either in India or in Malaya.

I. Cells of ovary 3-8-ovuled; cells of capsule 1-3- or more-celled.
  1. Stout plant with large leaves; seeds 3 or 4 in a cell, smooth ... ... 2. *A. lineolatum.*
  2. Tufted herb; seeds 5 or 6 in a cell, superposed, sharply 3-gonous ... ... 4. *A. scapiflorum.*

II. Cells of ovary 2-ovuled; cells of capsule 2-seeded. Small herb, decumbent ... ... 3. *A. nudiflorum.*

III. Cells of ovary 1-ovuled; cells of capsule 1-seeded. Stout herb ... ... 1. *A. conspicuum.*

1. **Aneilema conspicuum** Kunth. is found in the Patkai Hills of Assam, whence it extends to Burma and Siam, Penang, Malacca, Sumatra and Java.

The plant is used medicinally by the Malays, and is said to be a powerful emmenagogue.

Malay: Poko tampoh kalin—.

2. **Aneilema lineolatum** Kunth. occurs throughout Tropical India; in the Western Ghats from the Konkan to Travancore; and from Sikkim, Bhotan and the Khasia Hills up to 2-4,000 ft., to Burma, Malaya and the Malay Islands.

The plant is used by the Malays as an abortifacient.

Malay: Poko mati hidup—.

3. **Aneilema nudiflorum** Br. is to be found throughout India; from the North-West Himalaya ascending to 6,000 ft. eastwards and southwards to the Khasia Hills, Burma, the Deccan, Travancore and Ceylon. It is a common weed in waste ground and dry sandy places throughout the Malay Peninsula. It is also met with in China.

The herbage cooked in oil is employed in the treatment of leprosy and ringworm.

Malay: Rumput kurunit, Rumput lipah lumbu, Rumput sarang tupai, Rumput tapah burong—.

4. **Aneilema scapiflorum** Wight is a native of the Himalaya. It is spread from the Upper Gangetic plain to Bhotan, Travancore, Tenasserim, Ceylon and the Shan Hills.

The root is said to have astringent and tonic properties. It is considered useful in headache, giddiness, fever, jaundice and deafness. It is also regarded as an antidote to poisons, and as a cure for snake-bite.

The root-bark dried in the shade is said to have been employed with benefit in asthma. It is commonly used in colic, piles and infantile convulsions. It is a remedy of great repute for impotence and spermatorrhoea and also for incontinence of urine.

The dried powder is much used in combination. Mixed with sugar it is employed as an aphrodisiac. With the juice of the *tulsi* leaves it is given for pains in the kidneys, and is one of the chief remedies used by the Hakims in spermatorrhoea. With long pepper it is prescribed in bites of mad dogs, both internally and externally.

Mhaskar and Caius have shown experimentally that the drug is not an antidote to snake venom.

Bengal: Kureli—; *Gujerati*: Sismulia—; *Hindi*: Siyahmusli—; *Persian*: Musli-e-riyah—.

COMMELINA.

This genus includes 115 tropical and subtropical species.

Many species are used medicinally in various parts of the world:—*C. communis* Linn. in China; *C. pallida* Willd. and

C. tuberosa Linn. in Mexico; *C. deficiens* Herbert in Brazil; *C. barbata* Lam. and *C. benghalensis* Linn. in La Reunion; *C. madagascarica* C. B. Clarke in Madagascar; *C. africana* Linn. and *C. benghalensis* Linn. in South Africa; *C. nudiflora* in the Gold Coast.

The species used therapeutically in India number five.

I. Capsule 3-celled; two cells with 2, and one with 1 seed.
  1. Leaves elliptic to ovate-lanceolate, 2 to 3 in. long, glabrous; seeds cylindric reticulate, black ... 2. *C. nudiflora.*
  2. Leaves linear-lanceolate, 3 to 6 in. long, nearly glabrous; seeds globose, smooth, truncate, black powdered with white ... ... 4. *C. salicifolia.*
  3. Leaves elliptic or ovate, blunt, 1 to 3 in. long, pubescent; seeds closely pitted ... ... 1. *C. benghalensis.*

II. Capsule 3-celled, subequally 3-valved.
  Leaves lanceolate oblique acuminate, many-nerved, 6 in. long; seeds ellipsoid compressed, lead-coloured, margins often marbled ... ... 3. *C. obliqua.*

III. Capsule 2-celled.
  Leaves ovate-lanceolate acuminate, 3 in. long, scabrid pubescent; seeds ellipsoid rugose, straw-coloured or brown ... ... 5. *C. suffruticosa.*

1. **Commelina benghalensis** Linn. occurs in the peninsula of India generally, and is fairly common everywhere. It is also found in Ceylon, Burma, the Malay Peninsula, China and Tropical Africa.

The plant is described by Ayurveda as bitter, useful in leprosy, and a good regulator of the nervous system.

In La Reunion the plant is reputed emollient and mucilaginous. It is much used in the form of a decoction as a drink, a lotion or a bath.

The Sutos prepare from it a medicine for treating barrenness in women.

Bengal: Kachradam, Kanchara, Kanchura, Kanshira, Kanuraka—; *Canarese*: Hittagani—; *English*: Day Flower, Dew Flower—; *Gujerati*: Mhotunshishmuliyun—; *Hindi*: Kanchara, Kanuraka—; *La Reunion*: Grosse herbe d'eau, Grosse trainasse—; *Malay*: Rumput mayiam—; *Marathi*: Kena—; *Pampangan*: Biasbias—; *Philippines*: Alibangon, Anagalide azul, Uligbonggon—; *Punjab*: Chura, Kanna, Khanna—; *Sanskrit*: Kanchata: Marishajalaja, Paniya, Tanduliya—; *Santal*: Kana arak—; *Sind*: Chura, Kanna, Khanna—; *Sinhalese*: Deyamainaireya, Diyameneriya—; *Spanish*: Anagalide azul—; *Suto*: Khotswana—; *Tagalog*: Alicbanggon—; *Tamil*: Kanangakarai—; *Telugu*: Nirukassuvu, Vennadeviruka—; *Twi*: Onyame bewu na mahu—; *Visayan*: Cabilao, Sabilao, Sabilaonggalabaan—.

2. **Commelina nudiflora** Linn. is very common in waste land everywhere. It is frequent in Bengal and extends to Burma, the Malay Peninsula and Ceylon. It is distributed to most of the tropical and subtropical countries: Africa, Madagascar, the Seychelles, Mauritius, the Sandwich Islands, Australia, etc.

The leaves are used by the Malays for poulticing sores.

The natives of the Gold Coast Colony use the plant to cure a disease called 'okwaha'—a swelling in the groin—producing very itchy spots and sores and swellings. The leaves are pounded, mixed with the seeds of *Leea guineensis* G. Don. and those of long pepper. The mixture is then put in a plantain leaf, which has first been warmed to prevent it from splitting too easily, applied to the affected parts, bound, and kept there for three days. The application first affords relief; and when it is removed on the fourth day it is found that the swelling bursts.

Ashanti: Onyame bewu na mawu—; *Awuna*: Agbenokui nokui, Agbormaku maku—; *English*: Day Flower, Dew Flower—; *Ewe*: Agbenkui nokui, Agbormaku maku—; *Fanti*: Nyame bewu ansang na mewu—; *Ga*: To lilairy—; *Gujerati*: Shishmuli, Shishmuliyun—; *Hausa*: Balasa, Balasaya, Kunungura—; *Hindi*: Kanshura—; *Malay*: Pulau aur, Rumput kukupu, Tapak eti—; *Marathi*: Kina, Velichibhaji—; *Nzima*: Nyamele wua ngwosu—; *Philippines*: Aligbangon—; *Sanskrit*: Katsapriya, Koshapushpi—; *Spanish*: Anagalide azul—; *Twi*: Onyame bewu na mawu—.

3. **Commelina obliqua** Ham. is common over the low moist parts of India, flowering during the rainy season chiefly. It also occurs on the lower Himalaya, ascending up to 7,000 ft. in altitude. It is distributed to Ceylon and Burma, and hence to the Malay Peninsula where it is mostly found in the shady spots of the forests.

The root is a refrigerant and laxative, useful in strangury and costiveness. It is used in vertigo, fevers and bilious affections, and as an antidote to snake-bites.

Mhaskar and Caius have demonstrated that the root is not an antidote to snake venom.

Bengal: Jatakanchura, Jatakanshira—; *Bijnor*: Kana, Korna—; *Hindi*: Kana, Kanjuna—; *Kumaon*: Kanjura—.

4. **Commelina salicifolia** Roxb. is common in wet places in the peninsula of India, especially in Bengal, Coromandel and Bombay. It is distributed to Burma and to the Malay Peninsula where it is met with in abandoned rice-fields. It also occurs in Java.

The plant is used in dysentery and insanity.

Bengal: Languli, Panikanchira—; *Hasada*: Madtonggaara, Madtonggatasad—; *Hindi*: Jalpipari—; *Sanskrit*: Jalapippali, Languli, Langulu—; *Santali*: Bir kana arak'—.

5. **Commelina suffruticosa** Bl. is a native of Bengal. It is found in Tropical India from Nepal, Sikkim and Bengal to Central India and the Malay Peninsula. It is distributed to the Malay Islands.

The Santals apply the root to sores.

Santali: Dare orsa—.

CYANOTIS.

This genus consists of 35 palaeotropical species, two of which are used medicinally in India.

1. Cymes enclosed in biseriate falcate imbricating bracteoles ... ... 2. *C. tuberosa*.
2. Cymes from the leaf sheaths axillary ... ... 1. *C. axillaris*.

1. **Cyanotis axillaris** Schult. f. is a herbaceous annual, met with in many parts of India, in the plains from the Upper Gangetic valley to Assam and southwards to Ceylon. It may be found in rice-fields in some parts of Malaya. It is distributed to Siam, China and Australia.

The Indians occasionally drink a decoction of the plant for dropsy.

On the Malabar Coast it is considered as a useful remedy in tympanitis.

In Behar it is used as an external application in cases of ascites, especially when mixed with a little oil.

Bombay: Itsaka—; *Hindi*: Baghanulla, Soltraj—; *Jolo*: Hauli—; *Tamil*: Nirpulli—; *Telugu*: Golagandi—.

2. **Cyanotis tuberosa** Schult. f. is found in Chota Nagpore, the Deccan Peninsula—on the west side from the Konkan to Travancore—and in Ceylon.

The root is given in long-continued fevers, and also for worms in cattle.

Santali: Hodojerengarak , Meromchunchi—.

FLOSCOPA.

The genus consists of 15 tropical and subtropical species.

Floscopa scandens Lour. occurs throughout tropical India, in swamps from Eastern Nepal, Sikkim and the Khasia Hills to Travancore, Ceylon and Malacca, where it is common in muddy ditches. It is distributed to Eastern Asia and tropical Australia.

In Lakhimpur (Assam) the juice of the stem is put into sore eyes.

Lakhimpur: Karahimlu—; *Malay*: Rumput kumpai tikus, Rumput tapak eti—.

ABOUT SPIDER COLLECTION.

BY

T. V. SUBRAHMANIAM.

(*With* 1 *plate and* 8 *text-figures*).

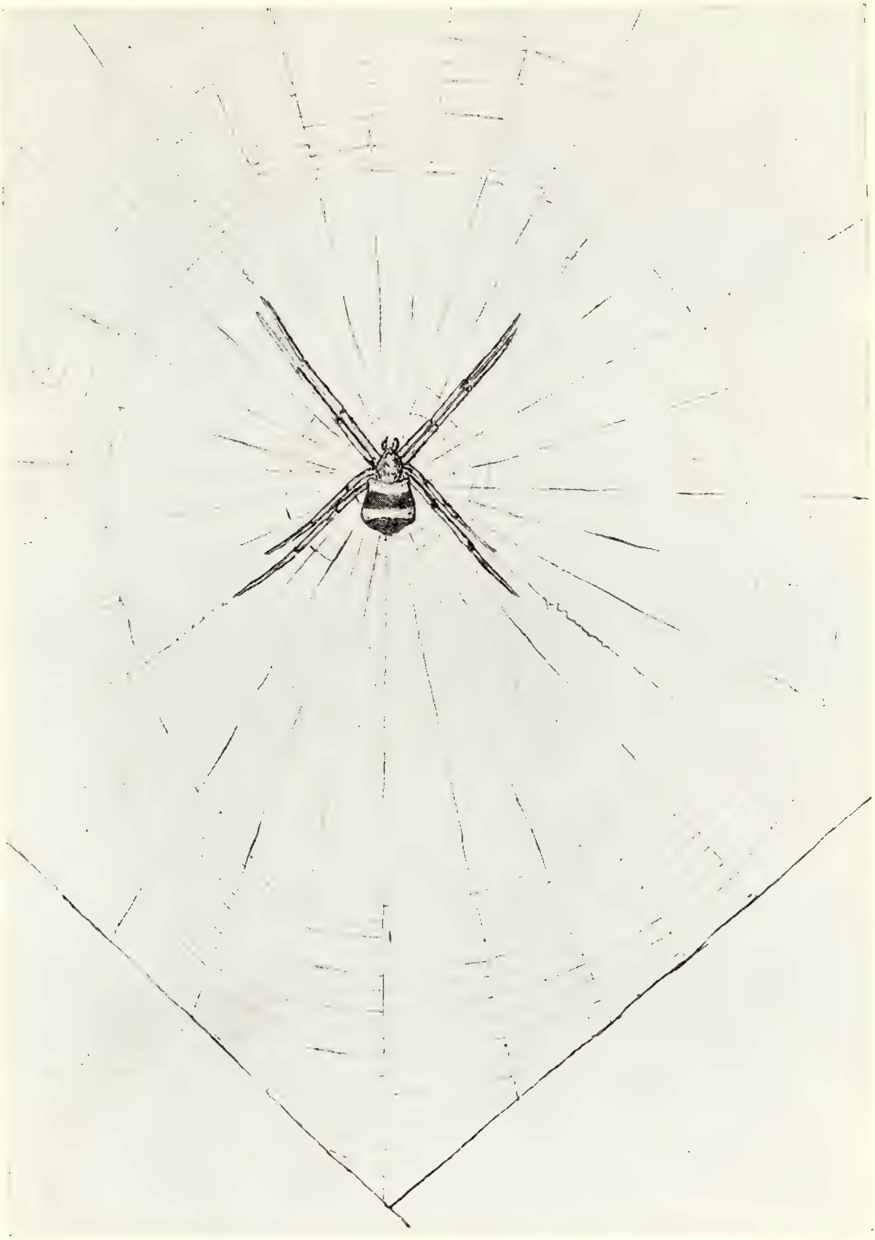
We look at a butterfly or bird with admiration and love. But the spider! the very name we abhor. Perhaps this dislike on our part is due to its lack of attractiveness or beauty. Volumes have been written about butterflies and birds but comparatively little interest is taken in spiders. Much remains to be done before we can have a complete list of them. The Morphologist with his books and microscope can name the specimen in his hand. But he has got a poor stock with him. He looks to the Field Naturalist to assist him with specimens. To his disappointment the collector brings him butterflies and birds, but no spider.

Our negligence, however, is not wholly justifiable. A study of the habits of spiders, of their infinite variety reveals a field of great interest. Their strategic ways of concealing themselves from their enemies and their perseverance in building their complicated webs are engrossing subjects. One who is interested in field Natural History, therefore, can well spend an hour daily in collecting spiders. Experience will justify that it is both an interesting and paying hobby.

For a better appreciation of this note I give below a short account of spiders and also some of the characteristics of a few of the main families which are commonly found in India. I have not attempted to give a comprehensive description of all the families. If the collector desires to know how spiders are identified he will have to consult some standard reference book such as the volume on *Arachnids* by Pocock in the *Fauna of British India.*

Spiders form a large Order known as *Araneae* under the Class of *Arthropoda*, the *Arachnida.*

They are distinguished by two characters: a round and unsegmented abdomen (except in *Liphistiidæ*) and a distinct waist between the cephalothorax and the abdomen. The cephalothorax is covered by a single dorsal shield—the carapace. The eyes are usually simple, six or eight in number, arranged in two rows, the anterior and the posterior lines. The arrangement and the disposition of the eyes are important in the classification. At the posterior end of the abdomen are two to four pairs of knob-like prominences, the spinnerets, with which the spider spins its threads. The mandibles or chelicerae are two-jointed with openings of the poison glands. The pedipalps in the males are modified to aid in fertilization into what are called Palpal organs. There is a marked sexual dimorphism in spiders: the females being larger than the males. The female spider lays a large number of eggs in a season all enclosed in a cocoon, which varies in size and shape. The young when hatched out resemble the parent except that they are minute in size.



Argyope and its web.

According as the abdomen is segmented or not the whole group is divided into two: *Mesothelæ* and *Opisthothelæ.*

The Mesotheles include a single family the *Liphistiidæ.* The tribe is distinguished by a segmented abdomen. They have aggregate eyes set on a distinct tubercle but this is not a characterstic possessed by the *Mesothelæ* alone. Some *Opisthothelæ* e.g. *Theraphosidæ* have also eyes set on a tubercle. The spinnerets are eight in number situated in the middle of the lower surface of the abdomen.

All the common spiders with which we are familiar come under *Opisthothelæ.* Here the abdomen is unsegmented and the spinnerets are six or less in number situated at the posterior end of the abdomen. There are two divisions under *Opisthothelæ,* the *Mygalomorphæ* and the *Arachnomorphæ.* In mygalomorphic spiders the basal segments of the mandibles project forwards from the fore-extremity of the cephalothorax, the articulation lying in a vertical plane. In Arachnomorphic spiders, on the other hand, the basal segments of the mandibles project downwards from the extremity of the cephalothorax the articulation lying in a horizontal plane.

MYGALOMORPHIC SPIDERS.

Atypids.—Spiders with coxa of palp having a large maxillary process. Six spinning mamillae; carapace anteriorly broad with median conical ocular tubercle; large mandibles without rastellum; weakly-spined legs with three claws. They inhabit burrows in the ground.

Ctenizids.—Differ from the *Atypids* in the presence of a mandibular rastellum; coxa of palp without large maxillary process; only four spinning mamillae, anterior pair contiguous and posterior ones usually short; tarsi without ungual tufts. They are brownish black in colour and are common under stones. Some of them are trap-door spiders.

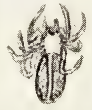
Diplurids.—Resemble *Ctenizids* in having three claws without ungual tufts. No mandibular rastellum. Again, posterior spinnerets are long and anterior ones widely separated.

Barychelids.—Medium-sized spiders (except one genus *Sason*) with mandibular rastellum (like *Ctenizids*) but unlike the two preceding families possess ungual tufts and only two weakly-toothed claws; spinnerets are like those of *Ctenizids.* They are burrowing in habit some being trap-door spiders.

Theraphosids.—Medium- or large-sized spiders differing from *Barychelids* in having apical segments of posterior spinnerets cylindrical and as long as the second segment; rastellum absent; eyes like those of *Liphistiidae* set on a distinct tubercle. Common under stones and in natural crevices.

ARACHNOMORPHIC SPIDERS.

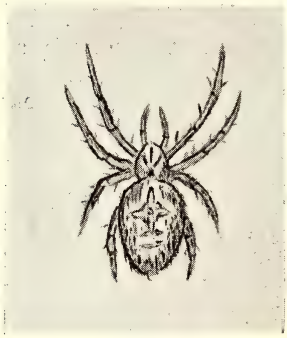
Eresids.—Are small- or medium-sized spiders of dull white colour. Cephalic region of carapace wide and usually high with low clypeus. Four median eyes form a small quadrangle, narrower in front. Anterior lateral eyes on either side of the head, posterior ones far removed from rest. Mandibles flattish in front; fang-groove scarcely toothed. Maxillae inclined obliquely inwards; legs strong and weakly-spined. Abdomen oval. *Eresids* and *Psechrids* possess a spinning plate or cribellum in front of the anterior mamillae.



1. Eresid.

Psechrids.—Medium-sized cribellate spiders. Unlike the above they possess slender legs, anterior two pairs being longer than the posterior two. The tarsi with ungual tufts. Head moderately elevated with clypeus high. Mandibles strong and toothed below. Abdomen oval or cylindrical.

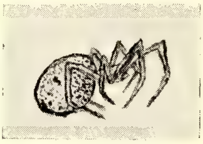
Hersiliids.—Hunting spiders found usually on the bark of trees and under stones living in irregular webs. Carapace as wide as long with cephalic region raised but narrow. Eyes of anterior and posterior lines both recurved; weak mandibles at most weakly-toothed below; maxillae inclined obliquely on labium; legs except third pair long and slender. Abdomen short. Posterior spinnerets very long; colulus or a mamilliform process present.



2. Argyopid.

Argyopids.—Sedentary spiders spinning geometrical webs. Carapace with clypeus low. Lateral eyes on the sides of the head typically close together away from the median quadrangle. Mandibles strong and movable and with strongly-toothed fang-grove. Maxillae not inclined on labium. Legs strong. Abdomen large and variable. Spinnerets subequal in length; a colulus is present.

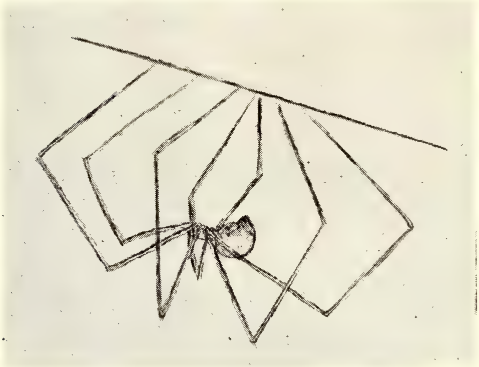
Theridiids.—Small spiders with oval abdomen. Differ from *Argyopids* by the presence of a set of spines forming a comb on the tarsi of the fourth pair of legs and by the untoothed fang-groove. Moreover the clypeus is usually high. Their webs are irregular.



3. Theridiid.

Urocteids.—Carapace reniform, rounded in front and emarginate behind; eyes compact; mouth parts weak. Short but strong legs subequal in length with spines. Abdomen truncate anteriorly, oval behind; posterior spinnerets longer than anterior ones. A colulus is present. Anal papillae present furnished with a fringe of hairs.

Pholcids.—Carapace flat and round with a distinct groove; clypeus high; head small and abdomen large. Anterior median eyes, very small, others large forming a group on either side of clypeus. Legs very long and slender. Common in corners of houses. They construct irregular webs.

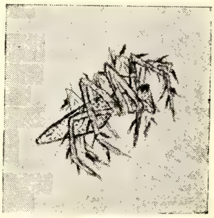


4. Pholcid.

Lycosids.—Poisonous hunting spiders without a regular web (except *Hippasa*); carapace narrow in front, high. Eyes of posterior line recurved and large, anterior ones usually small and compact; mandibles strong and with toothed fang-groove; maxillae short not inclined inwards; legs strong and spiny; abdomen oval rarely elongate; spinnerets subequal.

Oxyopids.—Eyes form a compact subcircular group; anterior line recurved and the posterior procurved. Mandibles are weak and long weakly-toothed. Carapace oval and distinctly elevated; abdomen oval in front and narrowed behind; legs strong and spiny. Abundant in grass.

Attids.—Small-sized vagabond spiders without webs. They jump from place to place in search of insects. Legs strong; tarsi with ungual tufts and only two claws. Anterior median eyes very large, eyes of the posterior line forming a square on the sides of the head.

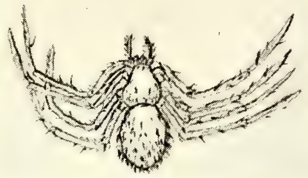


5. Oxyopid.

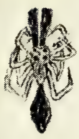
Clubionids.—Hunting spiders with powerful mandibles and toothed fang-grooves. Maxillae project forwards and not inclined on the labium. Legs strong and spiny with scopulate tarsi and protarsi. Ungual tufts present and only two claws. Anterior spinnerets in contact. Colulus absent. The carapace flat, usually wider than long; clypeus suppressed; the median eyes arranged in a recurved crescent. Tarsal claws unarmed (*Selenopineae*).

Sparassids (*Heteropodids*).—Differ from the above in having the carapace about as wide as long; the clypeus low; the median eyes forming a normal quadrangle and the claws armed with teeth.

Thomisids.—Small spiders with weak mandibles weakly-toothed. The third and the fourth legs shorter than the first and the second. When chased or frightened they move sideways and are hence called laterigrade spiders. In the general shape they resemble crabs in miniature and are called crab-spiders. Many possess protective colours. Some are excellent mimics.


6. Sparassid.

'Spiders being formed to a life of rapacity, their habits are calculated to deceive and surprise.' Being surrounded by enemies like birds, lizards and solitary wasps they are very dexterous by nature. Many possess various protective colours and so evade the collector's notice. Some are excellent mimics and the common *Myrmachene* is easily mistaken for the red ant. *Attids* and *Lycosids* are quick in their movements and easily conceal themselves. Altogether, the collection of spiders is not so easy a task as we expect it to be.


7. Ant mimic spider.

Luckily, spiders are ubiquitous. They live under diverse conditions: deep beneath the soil; in damp and moist places; in the scorching deserts and some even survive in hot-water springs. They have the power to withstand climatic and environmental variations. Locally they can be sought for in holes and crevices, in corners and along the walls of old houses, under stones and rubbish, along the bark and branches of trees, on the underside of leaves and in hundreds of other places.

No mathematically constructed or elaborate equipment is necessary in order to capture a spider, but only the overcoming of a natural repellance to these creatures and a keen eye. A medium-sized Kilner Jar (or any wide-mouthed bottle with a lid) containing some dilute spirit or formalin and a pair of forceps is all the equipment required.

Among the leaves of small bushes and trees many spiders hide themselves in search of insects. Shake a small branchlet of a tree or shrub with some force, and the spider if present either drops to the ground or hangs by its thread and toils to ascend upwards. Place the jar underneath and with a quick tap with the lid let the animal drop into the spirit. Replace the lid lest the animal escape. This is a method of capture usually practised by spider collectors.

Spiders which jump or run along the ground or stems of trees can, with a little nimbleness, be caught with the hand. Forceps may also be used to catch spiders but in so doing I have often failed and found my victim escaping from the forceps minus its limbs. A handkerchief, or a piece of cloth, will protect one from bites and the spider is better captured with the hands.

A butterfly net as is described in the *Bombay Natural History Society Journal*, vol. xxviii, No. 2, p. 509, is also useful in collecting spiders. The net may be a little stronger and its colour need not be necessarily green. A sweeping stroke among bushes and grass will fetch numerous specimens which can be transferred into the spirit jar.

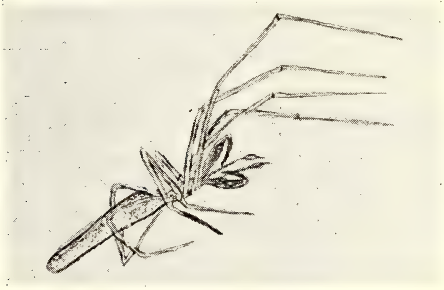
Members of the Family *Pholcidæ* are very common in unfrequented localities, in roofs and among rafters of old houses, in holes and hollows of trees—always remaining suspended and working their legs, at the slightest disturbance, like the Garden Harvestman (*Phalangium*). Their webs are of limited extension and irregular. But touch the web and the spider will try to escape you but it is not difficult to tap it into your jar. *Pholcids* as far as possible avoid bright sunlight and rain. They live confined in houses or in the shade of trees.

Members of the families of *Thomisidæ, Oxyopidæ, Argyopidæ* and *Clubionidæ* are usually arboreal: they can be collected in plenty in gardens.

Some *Thomisids* and *Oxyopids* live inside flowers and one may mistake their legs for the floral stamens. Such spiders besides protecting themselves from their enemies also easily prey upon insects which visit the flowers for honey.

No group of spiders constructs webs so attractively and with such geometrical precision as the *Argyopidæ*. Their prominent webs enable a collector to detect their presence easily. The webs are mostly octagonal and wheel-like in shape with a central hub or axis where the spider usually sits. From the central point various ribs radiate outwards and meet the external foundation lines. All the radii are further reinforced by concentric cross-threads. There is a fine description of the web of Araneus (*Argyopidæ*) and of the Giant Wood Spider, *Nephila maculata* (*Argyopidæ*) in the *Journal of the Bombay Natural History Society*, vol. xxviii, No. 3, p. 642.

Argyope is a gorgeously coloured beautiful spider belonging to this family. It sits in the centre of its spacious web. It is difficult to miss it. Other members like the *Tetragnatha* and *Argyroepeira* generally construct their snares among leaves of trees and plants, grasses or weeds standing near water. Many hide themselves on grass-blades or the green stems of plants stretching their legs in a linear fashion. At the slightest disturbance they run away or


8. Tetragnatha.

drop down by their threads. Place collecting jar under the dropping animal and it is yours.

Members of *Sparassidæ* and *Clubionidæ* construct small silken webs on the undersides of leaves. Some roll up the leaves into a cylinder and live within. Species like *Playstes flavidus* and *Peucetia viridana* are green in colour and are difficult to detect among green foliage.

Attids are vagabonds and do not construct webs of their own. Generally they are all small in size about ½ in. to ¾ in. in length. They are found everywhere: inside houses, on fences and in gardens. They are good jumpers and quick in movement. They leap from leaf to leaf and from plant to plant in search of small insects and spiders. *Attids* are exceedingly agile. Attempt to seize one and it will probably forestall you by jumping on your hand and with another jump disappear.

Eresids commonly construct irregular nets on bushes and branches of trees. The threads are white in colour and pasty to the touch. When disturbed they move very slowly along their snares.

The Common Indian Eresid is colonial in habit. Many live in a single saccular nest. The webs are generally constructed along fences or bushes bound about some of the twigs. The web resembles a cloth or paper irregularly folded. The size of the central house (the nest proper) varies according to the number of the members of the colony. There are numerous entrances to the house. Closely attached and forming a part of the nest there is usually an extensive sheet with strong foundation lines. This sheet is mainly intended to capture prey. I have seen an Eresidian web measuring about 3 ft. and whose foundation threads equalled ordinary twine in strength. It is a sight to see scores of *Eresids* pulling homewards an insect which has accidentally fallen into the net.

The collection of the colonial *Eresids* is easy. Tear open a net and shake the contents into the jar. You are sure to secure at least a dozen spiders. Solitary *Eresids* can be caught by the tapping method.

Of all spiders perhaps the most astute and cunning are the *Lycosids*. They cleverly escape the eye. Most of them are hunting spiders without proper abodes. The common *Hippasa*, however, constructs a tubular web by the side of stones among the leaf-whorls of pandanus, pineapple suckers etc., and by the buttress roots of trees. The tubes continue deep into the ground. Their mouths are strengthened by extensive additions of thread woven in irregular fashion. These spiders always sit at the mouths of their nests watching for visiting insects. At the sight of man they draw back into their deep retreat with astonishing rapidity. Unless the collector is as quick as the spider securing them is a difficult task. Even if caught with forceps the spider will leave its legs behind and save itself. The best way to capture one is to dig out the net, tear it open and catch the animal as it runs out.

Then there are spiders of the *mygalomorphic* group the most common genus being *Acanthodon*, of the Family *Ctenizidæ*. This spider lives under stones and rubbish. Its nest is generally a tube lined with silk, which (in all trap-door spiders) continues outside as a circular door protecting the entrance. These spiders can easily be detected by their dark colour and prominent abdomen. *Ctenizids* are bad runners and can be caught with the hands. The species *Acanthodon constructor* is common in Madras.

The spiders being killed when caught the next thing the collector wants to do is to preserve them. Sort out the collection and put the different kinds into separate tubes with slips of paper containing the following particulars:—(1) *Date of Collection;* (2) *Locality;* (3) *Collector's Name.* Close the mouths of the tubes with folded tissue paper. Immerse all the tubes in a big Kilner Jar containing light spirit or formalin.

A detailed description as to how a spider should be set and exhibited can be expected only from a Museum expert. In the Madras Museum the usual procedure is to fix the animal in its natural position on a mica sheet either with celluloid glue or in case of large specimens by stitching the legs and body of the spider carefully to the sheet. The mica sheet itself is inserted vertically into a glass jar containing spirit. Formalin may also be used but it hardens the specimens. The mouth of the jar is closed airtight.

There is no comprehensive list of all the existing species of spiders. If at all there are any they are in French. The only book that deals in a systematic way with spiders and is available to many is Pocock's Arachnida (*Fauna of British India*). A close examination of this book, however, will reveal that families like the *Attids*, *Thomisids*, *Theridiids* etc. are not entirely worked out. Among the living authorities on spiders I cannot mention but with gratitude the name of Dr. Gravely, Superintendent of the Madras Museum, under whose guidance I had the fortune to work for some months. His worthy additions to the Spider literature are of immense assistance to those who work in this line. He himself is an enthusiastic spider collector and there are many of his collections preserved in the Museum Laboratory. Our thanks are due to him for his excellent papers on *Clubionidæ*, *Sparassidæ* and *Argyopidæ*. He has supplemented and revised the old list of species. I am sure that a spider collector can get the most reliable and correct information regarding his or her specimens from the Madras Museum.

AN APOLOGY.

In the December 1934 number of this *Journal*, in an Article headed 'Hunter's Moon', Mr. Randolph Camroux Morris of Attikan Estate, Billigirirangan Hills, Mysore, wrote what purported to be a review on Major Leonard Handley's Book, *Hunter's Moon*, published by MacMillan & Co. in March 1933, 22 months before.

We desire to state that this article came to the *Journal* unsolicited and that it was published as a contribution without full appreciation of the reflection it might involve on Major Handley. We do not associate ourselves or the *Journal* in any way with any criticisms of Major Handley conveyed by the article. Also if the publication of this Article has in any way injured the character, credit or reputation of the Author, Major Leonard Handley, we tender our sincere apologies.

REVIEWS.

NATURAL HISTORY. Edited by CHARLES TATE REGAN, D.SC., F.R.S., Director of the Indian Museum, Natural History. 16 coloured plates and over a 1,000 photographs. Ward Lock & Co., London, 1936. 25*s*.

The term Natural History, to give it its wider meaning, is the study of the earth, the sky and the seas and all things animal, vegetable and mineral which they contain. But in the popular mind, it covers a more limited scope and is confined to the study of the Plant and Animal Kingdoms, or is limited more often to the study of Animals alone. The *Natural History* before us is a Natural History of Animals. Of the varying aspects of Nature, this is a subject which makes the widest popular appeal. The demand for books on Animals has been continuous. It has resulted in the production of numerous works which, in a single volume, more often in a series of volumes, have given in more or less detail an account of the Animal Kingdom.

But the progress of Science, exploration and research in various quarters of the Globe, are constantly throwing new light on various aspects of animal life and constantly adding to the sum of our knowledge. We are no longer content with discovering and describing new species of animals, though such discoveries particularly among the lower and no less interesting forms of animal life are constantly being made.

We are now more interested than ever in the study of animals under the conditions in which they live, their social and communal life, their relationship to each other, their adaptations to changing conditions, their food, their habits and their economic value. This study of animal life under natural conditions has brought out many new and interesting facts about them and has altered many previous conceptions. The data which the progress of Science has made available has rendered obsolete most of the existing works on Natural History. To provide, then, a comprehensive volume which would give a summary of present-day knowledge of the Natural History of Animals has been the objective of the present work. In these days of specialised knowledge, when scientists confine their study not to the great Classes of the animal kingdom, but to single family or tribe, no single man could deal authoritatively with so vast and complex a subject as Animal life in its entirety. It is a task which requires the co-operation of many scientists.

In producing this book, the publishers have been exceedingly fortunate in obtaining the co-operation of so distinguished a team of authors, each an authority in his special branch of zoology, who have contributed chapters to the book. The work of editing and presenting the picture as a whole has been carried out by Charles Tate Regan, the Director of the British Museum, Natural History. The result has been the production of an up-to-date compendium of concise information, accurate in detail, precise and scientific in its method of presentation. What is more important to the average reader, the book is written in a language which is intelligible. As such the book provides a good work of reference both to students and laymen. No popular work on Natural History would be sufficient without its complement of illustrations. There are 16 coloured plates in the book and more than a thousand photographs, most of them photos of animals under natural conditions. They reveal the great advance that has been made in Nature photography.

We recommend the book to any one who requires a readable and authoritative work on the Animal Life of the world.

S. H. P.

LES SERPENTS DE L'INDOCHINE. Par René Bourret. Two vols.; pp. 141 and 505. Toulouse: Henri Basuyau; 1936. Price Francs 40 and 110.

This excellent work will be welcomed by herpetologists all the world over; for, in addition to its high scientific standard, it presents a certain amount of originality in plan and treatment. The book is, moreover, clearly printed on a good grade of paper and its numerous illustrations—203—are above reproach.

The first volume is of a general character and deals with the ophidian fauna of Indo-China. It opens with an historical account which is a remarkable example of patient and painstaking research. The notes on morphology and distribution, and the tables for identification—based on external characters only—are very good; but that which marks the book as an indispensable addition to Indian libraries and laboratories is the bibliography, so very detailed and complete as to make future work in Indian serpent lore not only easy but pleasurable.

By means of judicious cross references this bibliography enhances the value of the synonymy in the second volume, and infuses life into an otherwise dull subject. This second volume contains detailed descriptions of 203 species and 49 varieties belonging to Indo-China proper, and 92 species and 24 varieties belonging to adjacent countries. The descriptions, the synonymy and the identification tables are all that could be desired. The volume concludes with an index in which some 1,400 names are listed.

Orders from India ought to be sent to R. BOURRET, *Institut océanographique de l'Indochine, Nha Trang, Indochine Française, French Indo-China.*

J. F. C.

QUESTIONS AGRICOLES. Paris: Editions du centre polytechnicien d'études économiques—Document No. 5; 1937. Pp. 266. Price 15 francs.

At a time when the improvement of agriculture in India is being generally discussed the perusal of this book will prove useful to many who are animated with the best intentions but little realise the complexity of the problem to be tackled. Let it not be objected that this is the work of Frenchmen debating the future of agriculture in their own country; the fundamental principles of agricultural research hold equally good for every country in the world, and they are here laid down with characteristic French conciseness and clearness.

J. F. C.

OBITUARIES.

A. J. W. MILROY.

By the death of A. J. W. Milroy, Conservator of Forests, Assam, on the 26th September 1936, was removed from our midst not only a man who had the cause of game preservation in India very close to his heart, but also one who introduced a new method of elephant hunting which revolutionised that art as practised in Assam.

Milroy's activities for the cause of Game Preservation in India are well known and he wrote much on the subject, but what is far better, he also translated his words into deeds. It is safe to say that no one knew the Kamrup or Kaziranga Game Sanctuaries as he did and it is also safe to say that no one will ever know them so well. During the activities of the far flung poaching organisation, financed by wealthy traders, which nearly wiped out the rhinoceros in these two sanctuaries in 1930, Milroy was indefatigable in launching a counter offensive which finally broke up the organisation and landed many of its members in jail. It is entirely due to him that we can now say that for the present these two sanctuaries are safe.

During his time as Conservator in Assam, a third Game Sanctuary has been added to the list. He was also instrumental in creating recently a buffalo sanctuary and it is hoped that his name will be perpetuated by having this sanctuary called after him.

It is not generally realised that modern methods of elephant hunting in Assam and the immense pecuniary gain the Assam Government has derived from this type of forest produce are due to this man who, by force of argument and personality, persuaded Government to allow him to try out his method which he had himself evolved due to his unique knowledge of that animal.

Prior to 1920, the hunting of elephants in Assam was in the hands of Assamese and Kampti Mahaldars, who paid a royalty to Government on each elephant caught. In these days it is difficult to realise, that the methods of only 16 years ago, involving the most unheard of cruelty to the animals, were ever tolerated for a moment. It is only charitable to think that the Government of those days did not know or did not realise that such cruelty existed.

A sketch of the methods of a native mahaldar, no matter how harrowing it may be to the feelings of those who love animals, must be given if the amazing transformation to modern methods is to be fully understood.

The method of catching elephants in Assam by which the herd is driven from a salt-lick to a stockade built nearby, or along one of their own paths into a stockade built astride it, is well known and Milroy himself wrote an illuminating article in the Bombay Natural History Society's *Journal* describing it.

In the old days it was thought by the native mahaldars that it was impossible to take *koonkies* into a stockade until the wild elephants had been weakened by hunger and thirst. Hence it was the practice to leave the herd in the stockade for anything up to a fortnight or even three weeks before any attempt was made to remove them. The condition of the animals after the lapse of such a period was beyond belief and cannot be imagined by anyone who has never seen it.

The interior of the stockade would be littered with the carcases of the calves killed by hunger, thirst or gored by maddened tuskers; the tails of the rest would have been bitten off. The picture of those left with sides fallen in, heads down and mouths open with blackened tongue protruding and covered with filth and blood would be a sight never to be forgotten.

Such was the condition of the stockade when the doors were opened and the sleek well-fed *koonkies* marched in and the captives were noosed. The wild elephants would be too exhausted to give any trouble in the stockade, but when dragged out the sight of the open jungle all around and perhaps some glimmerings of their life ahead would urge some of the stronger to make one last effort for freedom. Any attempt of this kind was promptly dealt with by the phandies, who slashed open the skin at the back of the neck where the noose fitted and rubbed some sand into the wound.

The tottering beasts were then dragged to the depot leaving a few more dead from exhaustion on the road.

Arrived at the depot the elephants were tied up fore and aft and the training proceeded on the principle that the more an elephant is hurt the sooner it learns obedience; hence spears were freely used. As may be imagined, the mahaldar did not engage any Veterinary Surgeon to look after the captures with the result that all abrasions went septic and the most appalling wounds, maggot infested, were a common-place.

Casualties during training were very high; as high as 48 per cent and for the whole catch might amount to as much as 80 per cent.

Such was the condition of elephant hunting in Assam when Milroy started his agitation after the War for more humane methods in hunting and training. He argued that a noble animal like the elephant would respond to kindness and humane treatment like every other animal, and that the methods hitherto in force could not be tolerated by any civilised Government.

He started on a small scale, and having become convinced of the truth of his arguments he obtained the permission of Government to conduct extensive hunting operations in the North Cachar Hills in 1920-22.

By his operations in the North Cachar Hills, Milroy at once revolutionised elephant hunting in Assam. In the two years, training casualties were reduced to 1 per cent and the total casualties to not more than 3 per cent.

How did this come about? In the first place must come the man himself. Milroy possessed the most wonderful personality and charm of manner. He spoke Assamese—particularly the Kamrup dialect, extraordinarily well. His knowledge of elephants and of jungle life generally was such that few Europeans acquire and anything that 'Milily Sahib' said would be sure to be favourably, if critically, considered around the camp fires in the training depots.

Naturally when he said that no wild elephants were to be left in a stockade more than 72 hours the wails of lamentation rose to heaven. Further when he said that no spears were to be taken into the stockade the phandies broke down weeping and said 'we are already dead'.

It was characteristic of the man that he rode a *koonkie* into the stockade that housed his first catch. What must have been his pride as he saw all the elephants taken out without a scratch.

In the depot it was the same thing. A trained Veterinary Surgeon was always present and wounds were properly treated twice a day: no spears were allowed and anyone who used one got a lambasting with the handle thereof.

By the time the operations were over Milroy's method was a proved success and that success has been repeated over and over again in subsequent mahals. This method is now accepted as the only method to be followed in Assam and woe betide the Assamese mahaldar whose casualties exceed the prescribed minimum.

Among other benefits his method proved that elephants could be trained in a very short time; that cruelty was not at all necessary in training; that casualties in the training depot could be reduced to almost negligible proportions; and that an elephant trained by a mixture of firmness and kindness was in every way superior to a broken-spirited animal trained according to the former brutal methods.

When elephant hunting, Milroy was indefatigable. He drove with the drivers or acted as doorkeeper at the stockade, or as one of the stops and often bestrode an elephant as a phandie in training. In fact he knew the business from A to Z. He refused to accept defeat and on one occasion he drove a herd for seven miles only to see it break through the wings and escape. Most men would have been content to call it a day but not Milroy. He roused the disheartened drivers and conducted them off by a short cut to the place where his knowledge of the country led him to believe the elephants were making for. He headed the elephants and drove them back and succeeded in capturing the whole herd.

Like all animal lovers, Milroy himself shot very little. He was, however, most generous to junior officers and most of those in the Forest Service in Assam have to thank him for their first tiger.

A man of most singular charm with a great sense of humour he is sadly missed by his numerous European and Indian friends.

N. L. B.

SIR GEORGE HAMPSON.

Sir George Francis Hampson, Bt., who died at his residence, Thurnham Court, Maidstone, at the age of 76, was a distinguished entomologist who was for many years on the staff of the Natural History Museum, London.

This is an ancient family descended from Henry Hampson, of Bradwell, Oxon, who was living in 1512. The first baronet, created in 1642, was Master of the Statute Office. George Hampson was born on January 14, 1860, the eldest son of the Rev. W. S. Hampson, rector of Stubton, Lincolnshire. He went to Charterhouse (Gownboys-Girdlestonites) in 1871, when the school was still in London, and left in 1875 for Exeter College, Oxford.

After taking his degree, he entered the Natural History Museum, South Kensington, in which he rose to be an Assistant Keeper. In 1896 he succeeded his uncle, Sir G. F. Hampson, Royal Scots Greys, who was a Crimean veteran, as tenth baronet. Sir George, who was a Fellow of the Zoological Society was the author of *Illustrations of Heterocera*, 1891-93, published by the British Museum, 'The Moths of India' in *The Fauna of India* series, published by the India Office, 1892-96, the *Catalogue of the Lepidoptera Phalaenae in the British Museum*, vols. i to xiii, and two volumes of supplement, 1898-1923, and *New Genera and Species of Noctuidae*, 1926. Hampson's volumes on the 'Moths of India', issued in the *Fauna of British India* series, were considered by him no more than a preliminary setting in order of a vast subject so as to reduce it to a workable state. To keep pace with the growth of the subject, which he dealt with in his work, he published a supplementary series of papers in the *Journal of the Bombay Natural History Society.* These papers were issued in 33 parts and were published between 1897 and 1911.

He married in 1893 Minnie Frances, daughter of the late Col. John Clark-Kennedy, of Knockgray, Kirkcudbrightshire; she died in 1928. They had, with two daughters, one of whom died unmarried, a son, Dennys Francis, who succeeds to the title. He was born in 1897, was educated at Eton and Christ Church, Oxford, and served in the Rifle Brigade in the War, when he was wounded.

DEV DEV MUKERJI (1903—1937).

We record with deep regret the death of Mr. Dev Dev Mukerji at Calcutta after a brief illness on the 21st of January, 1937. His death at an early age of 34 years is a great loss to Science. Of his several valuable contributions to Indian ichthyology, special mention may be made of the four reports which he published in the *Journal* of the Society. His exhaustive treatment of the Burmese fishes collected by Lt.-Col. R. W. Burton will ever remain a masterly piece of systematic research.

We extend our profound sympathies to the members of his family in their great loss.

S. L. H.

MISCELLANEOUS NOTES.

I.—OBSERVATIONS ON THE GREY MUSK SHREW (*SUNCUS CŒRULEUS*).

It is commonly accepted that this common shrew is mainly insectivorous, but though it feeds largely on insects, it also includes meat, bread and other dainties from the human larder in its menu. It also feeeds on refuse and small creatures that it can overpower.

The distress call of a Bull-Frog (*Rana tigrina*), presumably caught by a snake, attracted my attention late one night. Out I went to investigate. On reaching the spot I was surprised to find that the frog had been caught by a Grey Musk Shrew (*S. cœruleus*). The shrew held the frog down firmly and was chewing at its spinal column at the base of the skull. To my mind, the shrew's capture of the frog, was due partly to the frog's 'foolish' habit of sitting still and partly to the agility of the shrew. A frog will often sit quite still and allow itself to be gently touched before it will leap away. The frog was about four inches from snout to vent and the tables might just as well have been reversed, as these frogs are quite capable of swallowing shrews and other small mammals. This statement is supported by actual experience. In the *F.B.I.* (Mammalia), p. 237, Blanford writes, 'Sterndale quotes from the *Asian* an account of a shrew that attacked a large frog.'

As nothing appears to be recorded (vide *F.B.I.,* I.c) of the breeding habits of this shrew, I mention such instances as I have observed. The main breeding season, in Salsette Island, appears to be during the monsoon months, when food is plentiful. I have taken naked young from the nest in June, half grown young in July and August, and females with fœtuses during July, August and September. The number at a birth varies from two to four the latter number being rarely, if ever, exceeded. A rude nest of dry leaves, paper, rags or other oddments is constructed. In the collecting of the nesting material both parents take part. At nesting time, shrews are particularly destructive; this I learnt to my cost as a pair of shrews destroyed some of my manuscripts and other papers, bits of which I later found in the nest. Outside the breeding season they do little or no damage. The nest is usually secreted in a corner among rubbish, in a trunk or in a drawer. It is surprising what a narrow slit will admit them. The young do not leave the nest till about three-quarters grown.

When unmolested, this shrew becomes quite fearless. During the rains one frequently visited my writing table while I was at it and collected the insects that were attracted to the light. The particular individual had two young in a box behind my table.

On the whole it is a useful creature about the house.

Bombay Natural History Society,
Bombay.
October 25, 1936.

C. McCANN.

II.—BLACK TIGERS.

The *Evening News*, London, 10th October 1936, published an account received through Reuter's Agency, Assam, of 'a Black Tiger of the Royal Bengal Type' captured in a forest in Dibrugarh, Assam. According to Reuter, 'the Manager of a local Tea Estate set an iron cage with a bait inside. The tiger entered and was trapped'. The report adds that the animal 'was about 12 feet and is a rare specimen'.

The Conservator of Forests, Assam, requested by the Society to verify the report, kindly sent us a statement from the Accountant, Forest Office, Dibrugarh, who saw the animal after it was trapped, but was unable to get a clear view of it in its cage. The animal was trapped on the 4th September in the Nepaphoo Tea Estate owned by Bagchi Bros. of Dibrugarh and was subsequently sold to Messrs. P. K. B. Akuli of Barrackpore Road, Calcutta, dealers in wild animals.

Dr. Baini Prashad, Director of the Zoological Survey of India, Indian Museum, Calcutta, at our request made enquiries at Calcutta and was told by the present owner of the animal that it was a black leopard and not a tiger as described by Reuter.

The capture of a black tiger would have been an event! Though black tigers have been seen, in no single instance has a skin been obtained. Pocock in his monograph on Tigers (*J.B.N.H.S.*, xxxiii, p. 505) mentions three records of black tigers. One was the Black Tiger of Chittagong reported by Mr. C. F. Buckland in the *Field* (vol. lxxiii, p. 42, p. 789), whose letter was reprinted in the Society's Journal (vol. iv, p. 149). The animal was found dead and was too decomposed to remove the skin. The second was seen in 1913 by Mr. A. T. Hauxwell (*J.B.N.H.S.*, xxxii, 788) near Bhamo and was wounded by him but escaped. The size of the pug marks, 1 ft. 8 in. in circumference, indicated that the animal could not have been a leopard. The third record (*Field*, 1928, p. 656) is that of a black tiger found dead in the Lushai Hills, Assam. In this instance again the skin could not be saved.

In addition to these three records, there is a note by Col. S. Capper in our *Journal* (vol. xxiii, p. 343). Col. Capper when shooting in the Cardamom Hills, S. India, saw a black animal lying on a rock, which he examined through a telescope and which he believed to be a tiger. The presence of black leopards in the area where this black tiger was seen has given rise to doubts as to the correct identification of the animal—size being a very uncertain factor to rely on for the identification of an animal in the field. Similiarly, in the case of the black tiger seen and wounded by Mr. Hauxwell in Burma, it has been pointed out by Brigadier-General Burton in his book *Sport and Wild Life in the Deccan*, that the deceptive effects of light and shadow in the jungle frequently lead one to wrong conclusions regarding the colour of an animal.

The publication of Reuter's account referred to above of the trapping of a black tiger elicited letters from various correspondents which add further to the list of records of 'Black Tigers'.

Captain Guy Dollman of the British Museum, Natural History, in a letter to the *Times*, 14th October 1936, says that he received information of two cases of melanism in the tiger. Captain Dollman says the first refers to a young individual shot in the Central Provinces some years ago. The specimen was of a dark brown colour all over, with stripes appearing black on the dark ground. The second case concerns an animal shot in 1915 by some natives in Assam, east of Dibrugarh. This black tiger is spoken of as being a magnificent animal. 'There can be no doubt' says Captain Dollman 'that the animals I have referred to above were tigers and not leopards'.

Commenting on Captain Guy Dollman's letter, Mr. W. H. Carter (*Times*, 16th October, 1936) writes "I was much interested in Captain Guy Dollman's letter on black tigers in the *Times* of October 14th, having been resident in the neighbourhood mentioned by him for years. In one of the official district Gazetteers of Bengal (Khulna or Backerganj) there is mentioned a local variety of tiger which had lost its stripes as camouflage in the open sandy tracts of Sunderbans. The uniform colour scheme adopted was however, brown and not black, but perhaps his cousin in the hinterland found black more suited to his background. The author of the *Gazetteer* in question is, I believe dead'.

BOMBAY NATURAL HISTORY SOCIETY,
January 26, 1937. S. H. PRATER.

III.—RAVAGES BY TIGER AND INCIDENCE OF MAN-EATERS IN NORTH COIMBATORE BETWEEN 1860 AND 1880.

Coimbatore District Manual.

Felis tigris—The tiger is an inhabitant of all the jungly parts of the district. Of late years, prior to the Autumn of 1873, he appears to have increased and multiplied to an alarming extent in some of the taluks, but more particularly in those bordering on the rivers Moyar and Bhavani. The Satyamangalam taluk has been notorious for several years as the 'locale' of man-eating tigers. One of these terrible pests (a tigress) was shot at Kongrapalaiyam, a village eight miles east of Satyamangalam, on the 16th of August 1879, by Major Davies, Superintendent of Police in the Coimbatore district, and another demon of equal atrocity (also a tigress) was destroyed by Captain Caulfeild and myself by strychnine on the 14th of July, 1873, a few miles to the north.

It is an error to suppose that all man-eating tigers are mangy, or that they become so in consequence of having acquired this evil propensity. Both the tigresses here mentioned, as I can testify from personal observation, were as sleek as a Derby winner. Mange and want of condition are consequent on age and its concomitant infirmities.

In the Autumn of 1873, after our successful employment of strychnine, Captain Caulfeild was appointed tiger slayer to the presidency by the Madras Government. He at first confined his operations to the Coimbatore Collectorate (being ably assisted by the Collector, Mr. A. Wedderburn), and by means of poison, traps and other devices, he very soon materially thinned the ranks of the 'striped' family. In 1874, 93 tigers and 32 panthers were destroyed in the district. Only one man was killed, and the number of cattle destroyed fell from 2,183 in 1873 to 265 in 1874. These short statistics speak for themselves, and do not require any comment from me.

Mr. Wedderburn has very kindly furnished me with the following interesting particulars on the destruction of tigers, etc.:—

'The destruction of tigers was formally in this wise. When a cow or ox had been killed, the herdsman brought the intelligence; if there were shikaris in the village, they would go out, erect a platform of branches in a tree, or make an ambush of thorns on the ground, near the dead animal, and when the tiger returned about sunset they fired their long matchlock (with a barrel of five or six feet) loaded with a large charge of coarse powder and a bullet or two, and never missed their aim. In this way about twenty tigers were shot annually, but no great impression was made on their numbers, and the amount of cattle destroyed remained very much on an average. Occasionally by the intervention of the herdsman in defence of his cattle, he himself became a victim, and in this way one or two deaths occurred. But in one particular locality, under the hill range behind the town of Satyamangalam, a family apparently of man-eaters appeared. One, after committing great ravages, was shot by Major Davies, acting Superintendent of Police in 1869. After an interval of two years another appeared in the same locality, and was the terror of the neighbouring villages for nearly two years. The Magistrate of the District offered first Rs. 100, then Rs. 200 and finally Rs. 500 to any one who would shoot the pest; but it was much too wary to be approached. It carried off its man, partially eating him, and dropped him if pursued; and as the country was so difficult that it could not be beaten, it occurred to the Magistrate to ask permission to place strychnine in the body; but this was not approved of by the Government. Finally, however, this plan was adopted with success, and in July 1873 this scourge of the taluk was put an end to.

'The idea of poisoned baits then occurred as a good plan when the forest could not be beaten. Dr. Shortt, the Superintendent of Vaccination, suggested that the ointment of strychnine might be applied to a live bait, which, on being seized, would cause the tiger's death, but the plan did not succeed, the bait died of the ointment. Captain Caulfeild was appointed by the Government for the purpose of destroying tigers. As, however, his operations could only be conducted in one or two places at the same time, and the area of tiger-infested forest extended over some 200 miles, it occurred to the Magistrate of the district to ask Government to allow him to employ the headmen of all the villages in poisoning the carcases of cattle killed by tigers. It was in opposition argued that these village officers would destroy more lives by poisoning the cattle than the tiger had done, and a letter of warning was addressed to Government by an officer in a high position to that effect, but the Government did not appreciate the risk. So soon as permission was given, the Village Magistrates were supplied with small phials duly sealed, each containing six grains of strychnine, and were directed, so soon as the village herd reported a kill, to repair to the spot before sunset and apply the poison. The result was, that in fifteen months from the time of the plan being sanctioned, poison was applied in seventy cases, and thirty tigers were found dead near the baits, the others which had eaten disappeared; occasionally their remains, totally decomposed, were found at considerable distances, showing that though death had not been immediate, the animal had ultimately succumbed to the effects of the poison. Several tiger cubs were taken alive after vain search had been made for the dams which had eaten the bait. But the best proof of the effective remedy which had been applied was in the decrease in the losses of cattle—a matter of great importance to the ryot cultivators, who can ill afford to lose their cattle on which their cultivation so much depends. The losses of cattle fell in the short period of 15 months from 2,000 to a tenth of that number, and thus from £1,500 to £2,000 value of stock was saved to the people. The Government viewed this success with approbation.

'That with such extensive forests the race of tigers will ever be exterminated cannot be expected, but the number is reduced proportionately with the game on which they used to subsist while the number of guns now used by the people, who shoot in season and out of season—watching in the hot season by water-holes at which the poor animals of the forests and hills come to slake their thirst, and at salt-licks in the rains which are equally attractive—have greatly reduced their numbers. The common food of the forest tiger consists of wild pigs, which are most destructive to cultivation, so the tiger is not without its use in the animal economy, but it is not interfered with till it turns its attention to the villagers' cattle, and then its first meal frequently proves its last.'

Felis jubata (the cheetah)—This animal is only sparsely distributed over a small portion of the district bordering on the river Bhavani, about Vellamundi and Kotamangalam, where it preys on the antelope which abound in the vicinity of those places. Colonel Davies informs me that about four years ago, in looking over some skins of wild animals that had been killed in the district and sent to the Collector's office at Coimbatore, he saw five good skins of the *Felis jubata*, and that his impression at the time was that 'they came from the low hills about Kotamangalam'. 'I was surprised,' he continues, 'at finding the leopards' skins among the panthers', as I had not heard that *Felis jubata* was found in the district. The skins were in good order and undoubtedly those of *Felis jubata*.'

Mr. Wedderburn also informs me that he has seen skins of the hunting leopard at the cutcherry, and I think he has one in his possession now that was obtained near Bolampatti.

1623 to 1672—During this period the Compiler of the Manual states that wild beasts were so common, especially in the forest taluks, that one missionary lost thirty of his acquaintance within six months by their ravages.

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE. R. C. MORRIS.
September 27, 1936.

IV.—TIGER SMOKED TO DEATH IN A CAVE.

Tigers had been reported to have caused considerable loss and annoyance with their predilection for village cattle at several villages in Upper Burma. So persistent were their depredations that they caused the D.C. of the district to take notice and to issue an open invitation to sportsmen generally. Several parties visited the area, I was also tempted to help. I fear most were disappointed, but as is well known, news of tigers cannot be supplied or obtained with any accuracy or speed to enable sportsmen to be sanguine of success or even of getting a possible shot.

On arriving at the villages mentioned in the invitation I gathered that no recent news of tiger or kills had been received and that the tiger or tigers had left the neighbourhood.

However having arrived, I elected to stay a few days to look around and await possible news. Late one evening I heard casually that a tiger had attacked two bulls killing one outright and so severely mauling the other that it was not expected to live.

This occurred in a village several miles from where I was camped. Very early next morning, I proceeded to the scene of the kill and was just in time to see the carcase of a full grown tiger measuring between pegs 8 ft. 6 in., being carried out of a cave in which it had been asphyxiated that night with wood smoke. It was in its prime and in excellent condition. No part of its skin or teeth being damaged in any way.

The circumstances and procedure were as follows, and may interest your readers. The tiger had attacked and killed one of two bulls within 100 yards of the village, and then dragged the dead bull into a nullah and dined off a considerable portion of the carcase. It began its meal with the hump which was unusual!

Early in the morning the villagers led by a young man of 26, traced the foot prints to a cave or tunnel in the nullah further away. This tunnel was situated in a sharp bend of the nullah. It led through a promontory projecting on the nullah. The opening on one side was large enough for the tiger to enter, while the other opening was too small and narrow for the animal to escape. The entire tunnel measured about 30 ft. The villagers blocked the larger entrance with thorn bushes cut and collected in the vicinity, and put cross-pieces of young trees 3 or 4 inches in diameter, holding these in position by forked pieces 10 ft. long planted strutwise. The smaller opening was blocked up with rocks and earth leaving sufficient opening to fan in the smoke from a fire from a large pile of dried wood. This asphyxiated the tiger, but it was fortunate for the villagers that it 'was' dead when they opened the cave to ascertain the result of their labours. Pluck, coupled with fool-hardiness and luck is the only conclusion one can arrive at for the success of the enterprise. Had luck not served them some of them would have been hurt to a certainty.

18 Churchill Road,
Rangoon.
S. A. CHRISTOPHER.
October 16, 1936.

V.—TIGER LORE IN BURMA.

While sitting in the village an 80 year old Burman repeated to me a Burmese rhyme which I immediately recorded and I send it you. It is exceedingly interesting to me and it may interest your readers.

Kyaung a kyi—Gaung ga cie.
Thit a lat—Kha gah hpyat.
Kya a htwai—Hpin ga lway.

Literally translated is as follows:

A large cat—rides the head (begins meal at the head).
A medium leopard—cuts the waist (begins meal at the waist).
A small tiger—munches the stern (begins meal at the stern).

This is an allusion to the well known habit of the leopard commencing its meal with the stomach, while the tiger usually begins with the hind quarters of the kill. This must have been known to ancient Burmans long before successive sportsmen have come to the same conclusion.

The Burman believes that you are likely to get into trouble if you make a mistake in your food or the way you eat your food. The expression is '*A sa hma the*'.

The unusual way the tiger referred to in the note above began its meal, according to the wise old man, was a sure sign that it was to meet its death.

Another expression or legend known to ancient Burmans is the saying 'if a tiger had to depend on its nose (i.e. sense of smell) it would starve to death.' The controversy as to the acuteness of the sense of smell of the carnivora still goes on amongst sportsmen.

18 Churchill Road,
Rangoon.
S. A. CHRISTOPHER.
October 11, 1937.

VI.—YOUNG ELEPHANT KILLED BY A TIGER.

While on a shooting trip in the Cochin State during December 1935 I found a young elephant, 39 inches in height at the shoulder, which had been killed by a tiger.

Young elephant killed by a tiger.

The tiger killed the elephant near a swamp. It is difficult to say if the elephant was one of a herd or merely accompanied by its mother. The area in which the killing had taken place consisted of large clumps of bamboos, the surroundings were much trampled by elephants and numerous bamboos pulled down by them while feeding. It is possible that the young elephant was alone when attacked by the tiger.

It was killed by being bitten on the back of the neck. There was a large flap of skin torn back which may have happened when the tiger was shaken off. The shoulders and back were also marked by the tiger's claws. After being killed it had been dragged about fifty yards down a slight gradient and was hidden at the foot of a bamboo clump in such a manner that it would have been difficult for it to have been seen by vultures.

The elephant, according to my Kardar trackers, had been dead about three or four days and the tiger had been feeding on the two back legs and the saddle.

The kill was discovered by my seeing the tiger lying practically on his back and asleep at 9-30 in the morning. I fired at him with my .500 cordite, but due to the position he was in, the bullet was not immediately fatal. The tiger was able to struggle up and made for dense cover, where he could be heard breathing and in a bad way. He was left to die but during the night had made for water and entered a very thick piece of jungle into which it was impossible to follow up.

He was subsequently found dead and I had the skull and claws sent to me. The skull measurements showed him to be approximately 9 ft. 9 in. length.

TANJORE.
December 30, 1936.

C. H. BIDDULPH.

VII.—THE RESULT OF EXCESS POISON FOR WILD DOGS.

Wild Dogs have recently been killing cattle and calves to an alarming extent here; 'Atlas' poison was accordingly issued out to the herdsmen with careful instructions as to its use. Soon after this another kill occurred and the herdsmen, instead of pouring a little of the poison diluted by 50 per cent water into deep cuts and jabs all over the carcase as instructed, splashed the 'Atlas' neat over the kill thinking the results would be much more of a certainty. Seeing the herdsmen retire the dogs (a pack of twenty returned and fed, and in a few moments were staggering about obviously very sick; all the dogs were then seen to vomit up the meat they had devoured, and they then lay about with every appearance of feeling most uneasy. In about an hour however the pack got to their feet and straggled away, seemingly little the worse. Some days later the decomposed remains of one dog were seen, but the remainder apparently recovered and have been seen frequently since but appear to be fighting shy of cattle! This is a good example of the use of an excess quantity of poison on carnivoræ, be it arsenic or strychnine. It is essential to use the poison both diluted and sparingly. I lost a herd of 24 buffaloes through their being allowed to graze on my boundaries where the undergrowth had been treated with diluted 'Atlas' Tree-killer. A Planter in this district lost cattle through painting posts in a shed with 'Atlas' Wood-preservative, and cattle have been killed both in South India and Burma through their coming in contact with spots where skins had been treated with 'Atlas' Skin-preservative; in every case the material treated with 'Atlas' being licked by the unfortunate animals!

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE.
November 9, 1936.

R. C. MORRIS.

VIII.—THE STRIPED HYÆNA AS A MAN-EATER

The *Times of India* of the 11th July 1936, contained a report from a correspondent at Mainpuri, U.P., describing the depredations of a 'pack' of Hyænas which were said to be attacking and killing people in the Mainpuri District, U.P. In India, no authentic cases of Hyænas attacking and killing human beings have been recorded; further, as the instance of the Striped Hyæna—normally a solitary animal—hunting in packs appeared unusual, the Society referred the newspaper report to the Chief Conservator of Forests, U.P. for enquiry. We have since received from Mr. F. W. Champion, Deputy Conservator of Forests, U.P., a report on the incident by the Tahsildar, Mainpuri, forwarded to him by Dr. S. S. Nehru, I.C.S., Collector, Mainpuri.

The Tahsildar's report reads as follows:—

'With reference to letter No. 144/XXV-5, I beg to state that the animals referred to in the above letter are really hyænas and not wolves. The animals are striped and quite different from wolves.

'They were reported in an open area between Ali Khera and Jagatpur, Tikri and Hatpau villages in Tahsil Bhongaon.

'They killed a girl at Partapur and another girl at Sultanganj—both in Tahsil Bhongaon. Two Hyænas were killed—one at Tikri by thakurs with gun and spear and the other near Rampura by Banjaras. The latter were rewarded Rs. 10 by the District Magistrate.

'A third was killed by the Kanjars of Mainpuri at Saidpur Baghauli in this tahsil which adjoins tahsil Bhongaon.

'It is said that they are still near Tikri.

'Tahsildar Sahib Bhongaon had seen the killed animals. I have also seen one killed in this tahsil.

'It is called *Charkh* and *Lakar bhagga.* The head and the face of the animal were round.'

Pursuing the enquiry further we received the following report from the Superintendent of Police, Mainpuri:—

'The only case in which the animal or animals were actually seen taking any child away was that of a woman who was working outside in a field. She left her child lying on the ground and was attracted by the cries of the child. She looked up and saw an animal taking the child away in his jaw. She ran after the animal and rescued her child after a great struggle. She described the animal as one exactly tallying with the description of a hyæna. She was later on shown a dead animal and the skin of one and she confirmed the first impression. This does not leave any doubt in the matter, though this is the only sure testimony on the subject. Hyænas were killed and shot in a large number here after the reported outbreak, as the reward for their heads was increased after the reported incidents. The newspaper report published in the *Times of India* was not quite correct in details. For instance there is no evidence to the effect that the animals in question were seen in packs by any one. It is a common knowledge that wolves attack human beings only in packs and they move from one place to another very quickly. Wolves are known and recognised by every villager and the woman in question seems to be quite definite that it was not a wolf in her case, and also that the animal was alone when she saw her child being taken away.

'I personally think it was a Hyæna.'

The facts recorded above appear to provide evidence of a Hyæna attacking human beings and, at least in one case, the animal was seen carrying away a child. This is as far as we are aware the first authentic instance.

In India, the Striped Hyæna is a scavenger by habit though it occasionally attacks sheep and goats and more often dogs. In Africa, the Striped Hyæna appears to be far more aggressive. Writing of this animal in his *Somali Book*, Captain A. H. E. Mosse says that he was told by his shikari that it (the Striped Hyæna) will run amok amongst a herd of sheep and goats killing a dozen or more from sheer lust of slaughter'. He hardly credited the story at the time, but it has since been corroborated by Drake-Brockman (*Mammals of Somaliland*), who says that it is always an old animal that acts in this fashion and is then given by the Somalis the distinctive name of *Whera*, the usual Somali name for the Striped Hyæna being *Didhar*; while the Spotted Hyæna (*Crocuta crocuta*), a far more aggressive species, is known as *Warba*. This species according to Drake-Brockman frequently attacks human beings sleeping out in the open and sometimes attacks children.

The case of a Striped Hyæna attacking children as recorded above is probably an individual trait developed or developing in a particular animal. It may have been induced, as is frequently the case with man-eating tigers and panthers, either by the chance killing of a human being or from difficulty in finding food for the cubs.

Bombay Natural History Society, S. H. PRATER.
6, Apollo Street, Bombay.

IX.—A VERY LARGE SAMBAR STAG.

I yesterday shot from the Billigirirangan Hills, a Sambar stag (*Rusa unicolor*) carrying a very good head, measuring 38 in. and 36 in., one antler being 2 in. less. The horns were about a week or 10 days out of velvet; again this year Sambar are in hard horn early, but not so early as last year when many were in clean horn in August.

It was not so much the size of the head but of the animal's body that astonished me, it was unusually large as the following details will show:

Weight (ungralloched): 776 lbs.
Height at shoulder: 5ft.
Length of body: 7 ft. 4 in.
Length of tail: 1 ft. 2 in.

These measurements indicate an immense Sambar, which indeed it was. Dunbar Brander, in his *Wild Animals in Central India*, refers to another 'quite exceptional' Sambar weighing 707 lbs., measuring 59 in. at the shoulder.

Honnametti Estate,
Attikan P.O., *via* Mysore. R. C. MORRIS.
September 22, 1936.

X.—A BIG BUFFALO HEAD.

Seeing the measurements of a bull buffalo (*B. bubalis*) horn by Mr. Griffith I send you the measurements of a head in my possession which is as follows:—

Length on outside curve	Circumference	Tip to Tip	Widest inside	Widest outside
64¼″	19⅞	64	67	——

I acquired the head from the estate of the late Mr. Victor Iden, who was a relative of the Van Ingen family of Mysore. He was a keen shikari and before his death I very often accompanied him on shoots. In all probability he got the head in the Irrawaddy Delta in the neighbourhood of Kadonkani or Abya as I know he was a constant visitor to these parts. I regret I never got the particulars from him.

RANGOON, S. A. CHRISTOPHER,
September 23, 1936. BAR-AT-LAW.

XI.—GAUR BULLS ATTACKING A WOUNDED BULL.

An extraordinary sight was witnessed by Captain Napier (of Bangalore) and myself on the 22nd November 1936. Captain Napier had wounded a bull bison (*B. gaurus*), which prior to this had been 'milling' with two other bulls in the same herd, the breeding season being on. Far from taking afright at the shots the two bulls rushed up directly they saw their late antagonist fall and gave the unfortunate bull a very bad time as it attempted to rise; the rest of the herd also trotted up and stood around, interested spectators. On our approach the bulls and herd showed no haste in their departure, leaving the scene obviously reluctantly.

I have heard of similiar instances occurring in connection with stags in the rutting season; and have actually had two bull bison pass me within a few yards (both saw me), engaged in a running fight, without doing more than swerve aside, so wrapt up were they in their own affairs; here again during the breeding season.

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE. R. C. MORRIS.
December 3, 1936.

XII.—WHIPSNADE ZOO.

The Whipsnade Zoological Park has made steady progress since 1932 (vol. xxxvi, No.4, dated 15th December 1933) and members may be interested to have this supplementary account, the outcome of a visit by the writer in July of this year—1936.

It is not only within the Park that changes are apparent, for the attractions of the Zoo and the very favourable elevated site, are together causing development in several ways. On the north-western slopes of the Downs, where the great White Lion which is two hundred yards long affords a striking landmark, the planes of the London Gliding Club can be seen gracefully quartering the hillside like giant birds of prey; and along the main road just below are the beginnings of a Bungalow Town, complete with Golf Course and Club. Near by is the Dunstable Swimming Pool and the Whale Cinema. It is to be hoped this new Garden City will not become too large, and that ribbon building now in progress will be kept within reasonable bounds.

The number of animals in the Park is now near 3,000 and includes elephants, lions, tigers, bears, wolves, wild dogs, hunting leopards, bison, zebras, giraffes, large Indian rhinoceros, pigmy hippopotamus, llamas, wild horses, deer and antelope of several kinds, several species of cattle, kangaroos, wallabies, monkeys, chimpanzees, ostriches, emus, storks, cranes, and many of the smaller mammals.

A few of this host of creatures are necessarily kept in roomy fenced enclosures, or otherwise restricted in movement, but many are free to roam where they will within the beautiful five hundred acre estate. Such are the Chinese water deer, swamp deer, muntjac, kangaroos, wallabies, wild turkeys, cattle egrets, guinea fowl, and various species of pheasants and partridges; red and blue macaws, tame as any caged parrot, fly about without thought of wandering afield, and the indigenous Red Squirrel may be seen living at peace among his native firs.

Apart from the above most of the animals are in such large enclosures and paddocks that their movements are little restricted. It is a commonly expressed criticism of the Park that owing to the size of the enclosures the animals cannot be closely observed. Animals should not be thrust into a cage to be stared at from every angle. They should not be exhibited unless they can be observed in as close approach to their natural state as possible, and the first consideration to this end is space. It has been found at Whipsnade that even exotic creatures can live, thrive, and breed if given ample space and shelter in bad weather. Two of every kind there should be as it is certain that animals feel loneliness. Solitary confinement is a punishment much dreaded by human beings, and in a scarcely less degree it is a cruel infliction upon the unoffending creatures behind the bars. If visitors to Whipsnade allow sufficient time it is possible to view all the animals at sufficiently close quarters. Let those who like to see animals in cages go to the Zoo in London.

The Official Illustrated Guide gives a great deal of interesting and general information, including two suggested itineraries for visitors. Taking much the same walk as four years ago the new Elephant House at once attracts attention. Here are four elephants in circular glass-roofed stalls, each having access to a bathing pool. The building is in the modernist style and wholly suitable to the housing of the animals while at the same time not unpleasing to the eye, standing as it does with green lawns in front and backed by the greenery of firs. The attendants have excellent control over their charges by use of ordinary ash walking sticks instead of the iron driving hook of the Indian elephant driver. They have taught the animals several tricks. If you give the animal a coin it will not be surrendered to the keeper until a biscuit is tendered in exchange!

Near the elephant house is the new enclosure for hunting leopards now occupied by a pair of these easily tamed, handsome creatures. Close to it is a buffalo enclosure under construction, as also one for white-tailed gnus. During 1937 work will include the surrounding of 7 beech trees by a moat of water, so making an island for gibbons; and there will also be an enclosure for wild pig and wart hogs.

Tarzan Tree has been wired in to make a happy home for a number of Rhesus monkeys, and not far away is an island on which four young chimpanzees give a non-stop entertainment to delighted onlookers by their ceaseless antics. On the island are two bare limbed trees connected by a much used tight rope, and a monkey puzzle tree the ample foliage of which attests to the fitness of its popular name. The gift of a few pieces of cloth largely contributes to the merriment of the show and the obvious delight of animals and spectators alike.

The wild dogs have been moved to an enclosure near the wolves, the space so available being now a picturesque island and pond for flamingos and various species of waterfowl. It is good to note that the Tibetan mastiff is no longer 'exhibited'.

The tiger chalk pit is successfully used as a breeding enclosure while the new Tiger Dell gives to four of those animals the amenities of trees and natural ground, with sleeping shelters and a bathing pool. The four male lions afford a grand spectacle at feeding time. They have formed two pairs of pals. The lion which killed the man who ventured into the enclosure to retrieve a hat in 1933 is growing old—his head has a palsy shake and his jaw hangs loose, so at feeding time he is bullied by the opposite pair. It is obvious he is afraid to mingle with the others when the meat is coming along, and the slightest sign of an advance is met by roaring rushes and angry demonstrations. Then begins the spectacle of his pal savagely protecting him by charging at the aggressors. With teeth and claws a-bare he shoulders them off, rolls them over, tears out tufts of yellow fur, and it is only the distraction of the keeper's arrival with the meat which separates the furious combatants. Then each lion has his share—the old fellow last of all, and peace reigns—until next feeding hour!

Giraffes have a new roomy shed and enclosure near to which is a field in which the Great Indian Rhinoceros presented by the Prime Minister and Commander-in-Chief of Nepal leads a well fed and well bathed life of ease.

In Dagnall Paddock are yak, and in the long grass of Lay Meadow the sika deer of Japan and the sambar of South East Asia run almost as naturally free as in their native wilds; among them stalks the Sarus Crane. In the spacious Round Close, nilghai roam at ease with the Indian antelope which chase and display graceful high bounds just as they do in the plains of India.

By the side of the road near the Polar Bear enclosure is a toposcope dial, presented by Sir Chalmers Mitchell, giving the direction and distance to some twenty-five chief towns and villages.

One of the chief charms of Whipsnade are the open grass downs which afford such delighful walks. There is a grand panoramic view over the country, and if time permits a walk to the top of Ivanhoe Beacon will well repay the slight effort entailed.

This short account may well close with an extract from the Official Guide, for it so aptly sets out the aims and objects of the Society as to the future development of this spacious Park, which is the largest and best appointed of its kind in the whole world at the present time. 'The Society was a century old when it bought Whipsnade Park, and it proposes to develop it not as an ephemeral exhibition, but, slowly and surely, as a permanent addition to the beauties of England. It will be content if, at the second centenary, in 2029, its wise foresight will be applauded and its plans prove to have been well and truly made. Ultimately, it is hoped, every wild plant, tree, shrub or flower native to the chalk downs, upland pastures and rough woodland, will flourish; every British wild bird, resident or migrant, that the district suits will find itself in sanctuary, and the animals which have been introduced from other countries will live and breed in almost natural freedom, separated from the visitors not by visible bars and fences, but by ditches which do not offend the eye, and with concealed shelters, warmed where necessary by electric heaters.'

By road or by rail Whipsnade is but thirty-five miles from London so all who go to England should not fail to see it.

R. W. BURTON, Lt.-Col.

XIII.—DO BIRDS EMPLOY ANTS TO RID THEMSELVES OF ECTOPARASITES.

The day after I had read Mr. Salim Ali's very interesting note on the above subject in Volume xxxviii, No. 3, p. 628, I had the good fortune to watch a Song Thrush 'anting' itself—to borrow the term Mr. Ali suggests.

My wife and I were walking along the Sandgate Road in Folkestone, Kent, when the peculiar antics of the bird drew our attention. Although we approached to within six or eight feet, it continued to bathe in red ants which were issuing from a crack in the flags close to the railings. Not only did it pick up one, two, or sometimes three ants in quick succession and stuff them in between the tail feathers, into the tail-coverts, primaries, and under the wings, but, with tail and wings outspread, it often wallowed amongst the ants which could be seen swarming all over it.

It did not appear to me to be swallowing the ants, and I could plainly see many motionless dots adhering to the plumage which I feel certain were the squashed ants rubbed in by the bird. We watched the performance for six or seven minutes, until the bird hopped back through the railings on the approach of another pedestrian. Incidentally, it appeared to both of us to be in rather poor condition.

MEERUT, R. S. P. BATES, MAJOR.

January 8, 1937.

XIV.—SOME RARE BIRDS IN NORTHERN BURMA.

The following birds were obtained in 1935-6 in the Myitkyina district and the skins identified by Dr. C. B. Ticehurst, whose notes on them are given in square brackets.

Pomatorhinus ochraceiceps. Austen's Scimitar Babbler.

According to the *Fauna,* no race of this Scimitar Babbler is known between Karenni in Eastern Burma and Eastern Manipur. My skinner Lazum Naw, shot a male on March 8th, 1936, on the hillside below Laukkaung military police post, at about 4,000 ft. The iris was straw yellow with an outer ring of pink and the bill salmon-colour. [This bird matches the only two *austeni* in the British Museum, both of which (one is the type), came from Aimok, Manipur. There are seven specimens of *stenorhynchus* from Tengi Pani, Naga Hills, and Tippook. *Austeni* seems distinct in being greyer and paler above, and in having the flanks greyish-buff instead of warm-buff, but better series of both, and more knowledge of their distribution, are required.]

Sphenocichla roberti. Robert's Wedge-billed Wren.

My skinner, above mentioned, shot one on the same hillside out of a party of three on March 8th. He showed me the place a little later, a bamboo clump at about 4,300 ft. on the edge of a small dry ravine. The birds were in a comparatively open patch, whence firewood had been cut, and disappeared into the depths of an extremely precipitous and heavily forested evergreen hillside, which I later attempted to search twice without success. The hillside, in fact, is as difficult and impenetrable as anywhere I know in the Kachin Hills. I made notes of the soft parts at the time: iris very dark red, bill, upper mandible brownish-horny, tip gray, lower gray, blue-gray nearer nape, legs and feet dark chocolate-brown, claws horny brown. There are no previous Burma records, but it has occurred in North Cachar and Manipur. [There are only four specimens of this species in the British Museum from Konchung Peak, Manipur and Hemeo Peak, Naga Hills. Little is known about it.]

Turdus merula albocinctus. White-collared Blackbird.

I shot a female on February 11th, 1936, about 5 miles from N'Ding in the Hukawng Valley. I had previously, with glasses, had a view of what I was sure was a male near the same place. In this part of the Hukawng Valley, the new cart road runs for miles through magnificent evergreen forest with an undergrowth of ferns. The most noticeable features of the bird life were the numerous thrushes, *Oreocincla dauma* and *mollissima* and *Turdus dissimilis* all being obtained as they came out on to the road. This is the only record of this species in Burma. [I see no reason to suppose that this is a race of *merula* as described in the *Fauna.*]

Prunella immaculata. Maroon-backed Accentor.

Lord Cranbrook got specimens in the Adung Wang in 1931, and I had one sent me from the Laukkaung neighbourhood in March 1934. In March 1936 I found it common in pairs and small parties between miles 62 and 64 on the Seniku-Hpimaw road, where the mule track has been cut out of the solid rock, and paved with moss-grown rock. The accentors were either hopping up on the rock face or feeding among fallen leaves and brushwood on the edge of the khud. They were not at all shy and might have been mistaken for tree pipits as they flitted up into the bushes. At close quarters the gray head, maroon back and dark red under-parts are most distinctive. This must be a very local bird, as I saw 15 to 20 in about a mile of this particular section.

Delichon nipalensis. Nepal House Martin.

Mr. A. K. Thomson, Burma Frontier Service, sent me a skin of one shot by him on January 2nd, at Sumprabum (4,000 ft.), about 120 miles north of Myitkyina. He wrote 'A large number of them made their appearance—they disappeared in the evening. Snow has been visible on the Kumon range for the last three days and I fancy the extreme cold has driven the birds down here'. There is only one previous record of one obtained by Major Mears in the Upper Chindwin (date and locality not mentioned). [Besides Mears' record J. C. Hopwood has stated that this species breeds in the cliffs of Kyaukpandoung, Arakan, in April and May and that it is rare elsewhere. There seem to be no Arakan specimens, however, to bear out this record, nor is it mentioned in the Fauna.]

Delichon cashmeriensis. Kashmir House Martin.

I obtained one in February 1934 at Myitkyina (*Ibis*, April 1935). On January 15th, 1936 I saw a flock on the China border near Sima (4,500 ft.) and shot one out of a flock on January 19th just north of Myitkyina. A very large flock of swallows and sand-martins seen on a sand-band on January 28th also undoubtedly contained some of these birds.

This bird on the wing looks much more like a sand-martin with a white rump than *urbica* or *nipalensis*, both of which are steely-blue in appearance on the upper parts. [I have given reasons (*J.B.N.H.S.*, xxxii, 348) for believing that *cashmeriensis* is not a race of *urbica*; it seems, however, that it may well be a race of *daoypus.*]

Circus cyaneus. Hen Harrier.

There appear to be no published records of the Hen Harrier in Burma. I have more than once seen very white Harriers in Burma which I assumed to be *macrourus* but never managed to obtain one until January 26th 1936, when I shot a male Hen Harrier hunting in willow scrub on the Irrawaddy just below Myitkyina. Mr. T. R. Livesey says that he has seen it on the Inle Lake and there are numerous records from Yunnan. From an examination of specimens in the British Museum it is clear that the Pale and Hen Harriers would be difficult to distinguish when on the wing. Since Oates's day (1889) the published notes on all harriers are very meagre and I can find no later records of the Pale Harrier, so that it is to be hoped that some Burma naturalist will turn his attention to them.

Rallus aquaticus indicus. Indian Water Rail.

A specimen of this bird was obtained by Mr. J. A. Edwards of the Indian Police of March 9th 1935, a few miles north of Myitkyina. I had previously flushed a number out of a marshy corner of a jheel at Chaungwa in the Indaw Valley while duck-shooting in late January 1935, but the skin of the only one shot by me went bad and had to be destroyed. This bird is described in the *Fauna* as 'migratory in winter to Burma' but the only published records of any one having met with it are below. [Blyth recorded this bird from Arakan and Captain Shopland informed Oates that he had obtained it there, doubtless near Akyab where he was stationed. It is listed by Rippon as occurring on the Inle Lake, S. Shan States.]

Charadrius placidus. Long-billed Ringed Plover.

The only previous Burma record is of one shot by me on March 27th 1933 in the N'Mai Valley. I got one out of three on February 1st 1936, near Tasang on the Irrawaddy and thought I saw another near Myitkyina about a fortnight later. But it seems a rare bird, easy to overlook on the big shingle banks of the Upper Irrawaddy.

Nyroca marila marila. Scaup.

I shot a female scaup on a jheel near Katcho on November 10th 1935. It was with an immature tufted duck and one other (unidentified) duck and the whitish patch all round the face in front of the eye was most noticeable. There are no previous Burma records, but four from Chittagong and Assam.

August 1936. J. K. STANFORD, I.C.S.

XV.—CURIOUS NESTING SITES OF 'THE LARGE PIED WAGTAIL [*MOTACILLA LUGUBRIS MADERASPATENSIS* (GMEL.)]

In *The Birds of Southern India* by Baker and Inglis, mention is made of the fact that these birds nest in all sorts of places—in holes, wells, bridges and buildings, in crevices of rocks etc.

In 1934 several nests were found and in four instances the nests were built on the bottom flanges of small girder bridges on the railway over which more than twenty trains passed each day. The nests observed were in each instance directly under the running rails and not more than from 2 ft. 6 in. to 4 ft. below them.

It seems curious for these birds to have selected these bridges as the chances of rearing their young seem doubtful owing to the risk of splashes of hot water, oil, hot cinders and ash falling from passing locomotives destroying them.

Details of nests found are as under :—

(1) 1 -3-34. Nest with 4 fresh eggs.
(2) 10-4-34. Two nests in the same bridge about four feet apart, one with 4 eggs and the other with 3 eggs.
(3) 20-4-34. Nest newly constructed, eggs not laid.

TANJORE. C. H. BIDDULPH.
December 30, 1936.

XVI.—THE HABITS OF VULTURES.

A note on the eyesight of vultures was published in the last issue of the *Journal* by Mr. Dunbar Brander which is of much interest, as the habits of vultures seem to have escaped the notice of ornithologists to some extent. Mr. Brander's description as to how the vultures find the carcases and offal they feed on is largely correct, but I question the accuracy of some of his remarks on their habits.

Vultures do not start their soaring as early as he suggests. They are particularly late risers, and it is only after a good deal of shaking out of their filthy plumage that they venture to put it to the test of flight. Then they start out—like most birds—in the coolness of the morning to search for food—only they are later out than most. In big-game jungle, vultures may be seen in pairs, or solitary, quartering the hill sides looking eagerly down into the jungle for a possible tiger or leopard 'kill'. They work it methodically like a harrier at the various levels. It is only when the day begins to heat up that vultures in company with other birds of prey start their soaring—which is not, I think, as Mr. Brander supposes for the purpose of finding their food but to escape the heat of the day by keeping aloft at several thousand feet elevation. Of course they are on the lookout for food too—combining pleasure with profit—but I do not think food is their primary object in soaring. This habit of soaring of birds of prey is well known and observed by falconers. Vultures that are gorged with offal will omit of course the morning search for food, and they then sit in numbers on some high tree working it off, but most of them will be seen to go soaring up later in the day—as if for pleasure. The Jodhpur desert—for example—can be very hot at ground level—even for vultures, and by going up a few thousand feet they get into cool air.

Harriers and other birds of prey may often be seen soaring up with vultures and they are obviously not seeking their prey. They are seeking the cool air at a high altitude.

Mr. Brander describes very well how the sky is 'drained' of its vultures as soon as a carcase is found—vulture after vulture following on the direct and purposeful flight of those that give the show away—only it is not only the crow that gives the first indication. In many places crows are absent or scarce. Dogs, wolves and jackals are especially watched by vultures for this purpose and probably the big cats too.

On their own—without a pointer—vultures can be very silly and pass quite close to a carcase without spotting it. This is often to be seen when waiting in hiding for a tiger or leopard over a 'kill'. The inability of vultures to find such 'kills', points to their having little or no sense of smell.

Recently instances of vultures descending to feed on a tiger 'kill' by night have been recorded—presumably by moon light. In view of their terror of the tiger such instances are noteworthy. I have seen a tiger at noon charge out on to vultures that had the temerity to descend onto the 'kill', and leap up at them and try to claw them down—a pretty sight!

How long can vultures go without food? How often do they drink? There are a number of interesting questions to ask about these filthy fowl. The Lämmergeyer has always intrigued me for I have never seen one feeding yet!

Would Mr. Donald give us some information about the soaring of birds of prey?

TAUNGGYI, BURMA. T. R. LIVESEY.

September 30, 1936.

XVII.—EAGLES ON THE NILGIRIS.

A few years ago I was having a talk on the verandah of the Ootacamund Club with two sportsmen who were discussing their day's shoot on the downs. Their bag consisted of three or four jungle fowl, all hens, and a brace of woodcock, and they were deploring the shortage of game generally on the hills. My suggestion that the shooting of jungle fowl be restricted to cock birds only did not find favour, and when I remarked that perhaps the various eagles met with were responsible they told me there were no eagles here, and that if I meant kites or sparrow hawks, they certainly did no harm. Shortly after this I was asked by a lady if I would call round at her house to shoot a kite which was going off with her fowls and pigeons. I could understand the lady not knowing that it was not the common kite which was the culprit, but it surprised me very much that two men who were out with their guns every shooting season did not know better. When, later on, I was prompted to write an article on eagles to a certain newspaper I sent each of them a copy.

I have recently come across this article and find, that while my descriptions of these birds are such that will make identification easy to people like myself who have not taken up natural history as a study, they will not assist the naturalist readers of your journal in the same way. I am however writing these notes on the same lines and trust they will prove of interest.

There are three eagles on these hills. The Black eagle, Bonelli's eagle, and a bird which may be the Imperial eagle.[1] The last is not often seen and, I think, is only an occasional visitor. The first one I saw was on the hill above the Toda cathedral at the top of the Sigur ghat. It was on the summit of a cliff and was feeding on what looked like a hare. I was able to approach to within about fifteen yards when it rose and flew away from me, but it went only a short distance and then came at me with talons extended, and it was all I could do to keep it off with a heavy walking stick. I gradually increased my distance away from the kill, but it was some time before I got clear and felt safe.

I mentioned the story that evening to a friend, and he arranged to come out with me to the spot next morning. We were fortunate to see two birds this time. They were at first circling above us with a dozen or more vultures, obviously all interested in some dead beast in the valley below. Presently the two eagles separated from the others and flew over us at no great height. My friend felt sure they were golden eagles and I was not any the wiser at the time, but I have since been told that they may have been the Imperial eagle and I have seen three or four others since.

The bird is dark brown and closely resembles the Golden eagle, but it has not the same easy flight of either the Golden or the Bonelli's eagle, and I can well imagine it has not the speed of the latter.

THE INDIAN BLACK EAGLE (*Ictinaëtus malayensis perniger*).

This is a very handsome bird. All black except for its feet which are bright yellow. I have seen it at close quarters many times, and on one occasion I saw one chivy a snipe which I had put up near the Avalanche bungalow. It hunts after the method of the harrier, beating the hill side, and at times checking its flight and dropping into tall grass. I once drew a friend's attention to one which was beating over some low scrub, and his remark that it was a kite somewhat darker than the ordinary might be made by any one who was not a keen observer. It does not look much bigger than a kite, but the span of its wings is quite five to five and a half feet, and the greenish horny bill and fierce looking eyes proclaim it as something more savage than the homely old kite.

These eagles are to be seen, either singly or in pairs, all over these hills and especially where the plateau falls away to the low country. I have seen them on both the Gudalur and the Mettapalliam ghats.

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[1] [Neither the Golden Eagle nor the Imperial Eagle are known to occur on the Nilgiris. The Small Indian Spotted Eagle (*Aquila pomarina hastata*) has been obtained at Kotagiri.—EDS.]

Bonelli's Eagle (*Hieraaëtus fasciatus*).

These birds are common on the Nilgiris although I have never seen more than two at a time. I have also never seen one by itself. They hunt in pairs and put in some wonderful team work. It is surprising to know how very few people there are up here who have any knowledge about them, and it is pretty certain that many who keep poultry and pigeons think that the birds they have lost have been taken by kites or sparrow hawks, whereas the culprit is one which comes under the 'true eagle' class.

Pigeons are taken in flight while a chicken or perhaps a full grown hen is swooped on from a height and disappears before the owner is aware of what has happened. People on the Nilgiris who read this article might like to have a description of the bird, or would want to know where to look for it, and I can best describe it as having a white breast with the under-parts of the wing a browny white, and the upper parts a dark brown throughout. The wing expanse is a full six feet, and although this might be discredited when the birds are seen by themselves high up in the air, a better idea of their size is obtained if they are seen in close proximity to crows or kites. The description given will help towards identifying the bird, and I suggest that if a flock of pigeons is seen in flight over the bazaar, or any where else, a patient watch might be rewarded. Ordinarily the pigeons will be circling round together, but if it is noticed they have suddenly separated into twos and threes and commenced zig-zag and faster flighting it means they have spotted the enemy, perhaps a mile up overhead, or perhaps already on the downward swoop. The speed is terrific and the noise as they approach is just as though a huge rocket was going through the air. I have more than once seen a chase from start to finish, and although there are two eagles which do the pursuing it is usually only the one pigeon that they pursue. Sometimes the eagles hunt independently and chase two birds, but as a rule they rely on team work to make certain of getting one.

It is probable that while the eagles have been watching the pigeons from above they have been able to gauge the speed of the fliers and make their decision accordingly. A few young birds in a flock can, no doubt, be easily picked out, and perhaps the decision, to follow only one, is made if all the pigeons are mature and strong on the wing.

If it so happens that the eagles are seen before they have swooped, it will be noticed that they give the appearance of not being in the least interested. They move slowly, one behind the other, and the leader's dive is so sudden as to be almost unexpected. No. 2 waits a few moments till it knows which bird is to be chased and sometimes it makes a kill with its first swoop. If it misses, it allows itself to be taken up by the momentum of its dive, and a succession of dives may be repeated in this way. No. 1 eagle meanwhile pursues relentlessly, and whether the pigeon turns to right or left, or does a spiral dive or a quick rise, the eagle is just behind, and if it is not fast enough to catch up with the pigeon the other one is almost certain to get it. I don't say that all pigeons can be caught. I have seen some get away, but the fact that the average pigeon, which is a fast flier, can be caught, means that the eagle is gifted with considerable speed. The Bonelli does considerable damage among poultry and also takes toll of the small game on these hills, and I should not be surprised to know that a swoop down to the tanks in the low country supplies him with an occasional wild duck or teal.

Bonelli's eagle is to be seen on the Nilgiris at all seasons of the year and I think it must nest on the rocky crags of Mukerti or Nilgiri Peak, or perhaps on the cliffs above Masingudi. From two to three thousand feet below I have watched a pair fly out and return to a ledge on the cliff side where I feel sure there must have been a nest.

One wonders how this eagle gets its food during the monsoon when the skies are overcast for weeks and months at a time. It hunts in the open and needs good visibility to search out game, and apparently it never leaves its haunts, as I have seen a pair at work almost as soon as a blue sky has appeared after a lapse of many days. The solution must be that a flight of an hour or so would take it into bright sunshine either in a north easterly or south west direction according to the time of the year. Its hunting beat must cover a very extensive area when it is realized that if flighting a mile or so above the highest mountain tops, its range of vision can take in places so far as apart as Gudalur and Coimbatore in one direction, and Nilambur and Sathamangalam in another.

The flying man can best appreciate this but he has not the eye of an eagle. The eagle must do a good one hundred and twenty miles an hour on a downward flight so that a drop down from Dodabetta to Gudalur would not take much more than ten minutes.

It is curious how deceptive are the sizes of birds when viewed on the wing. I once pointed out two Bonelli's eagles to a man who estimated the span at three feet, which is just one half the actual size. I recollect also reading a report of an address given by a lady in Ootacamund, in which she mentioned the span of an albatross as very nearly four feet, and her audience were astonished to know that this gull was so big.

Some years ago I was travelling by steamer between Adelaide and Fremantle and dozens of these birds followed us for three or four days. Passengers were interested to know actually how big they were and the general opinion among them was that the wing span was not less than five feet, and all were surprised to learn from the ship's officers that ten feet[1] was nearer the mark. Occasionally one of these birds gets knocked out by coming into contact with the rigging and one which fell on deck was measured and taped out at over ten feet. Bonelli's eagle, as I have said, measures six feet. A certain buzzard on these hills is very like the Bonelli. Its flight is somewhat similar and it looks to be almost as big, but it can be distinguished by its darker breast and slightly striped colouring on the lower parts of the wings. I have not seen them hunt game and they take no notice of pigeons but on many occasions I have seen them knock down a honey-comb. It is in the bright sunny days of spring that Bonelli's eagle is most frequently seen, and it is also then a common sight to see them mobbed by crows. The reason is that the eagle sometimes goes off with a young crow as he would a pigeon and in consequence is hated by the tribe.

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[1] [J. F. Green (*Ocean Birds*, p. 5) says that the largest albatross out of well over a hundred measured by him had a span of 11 ft. 4 in. from tip to tip.—EDS.]

In concluding these notes I would like to say something about falcons. The Peregrine[1] and the Lugger are both found here at certain seasons and I have had opportunities to watch them on shikar. Both are destructive to small birds, and while both no doubt are capable of taking pigeons and poultry I feel sure that of the two the lugger does most damage. He kills pigeons and jungle hens bigger than himself, and for persistence in the chase has no equal. Bonelli's eagle can be scared off his attack on pigeons by shouting and clapping of hands, but nothing frightens the lugger. I saw one chase a pigeon for a full half hour and catch it eventually. The pigeon seemed to have the speed and at times got well ahead but the lugger did not give in, and the end came so suddenly that I think the pigeon gave up in despair. It collapsed in mid air when the lugger was some yards behind and was caught before it dropped to earth. The whole chase took place in a valley between two high spurs and the finish was immediately above me. I had the satisfaction of shooting the lugger as he came to earth astride the dead pigeon.

OOTACAMUND. H. E. BURGESS.

July 1936.

XVIII.—THE DISTRIBUTION AND NIDIFICATION OF THE GREATER SPOTTED EAGLE (*AQUILA CLANGA* PALLAS) IN SIND.

Hume considered *A. clanga* to be the commonest eagle in Sind. This however was in 1872 and the scene since has changed considerably. *Clanga* is no longer as abundant now as it was 64 years ago.

The Greater Spotted Eagle is a bird of well watered and fairly well wooded tracts, where rivers, perennial canals, swamps or lakes provide it with a plentiful supply of frogs, its staple food.

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[1] [The Peregrine (*F. peregrinus calidus*) and the Sahin Falcon (*F. p. peregrinator*) both occur on the Nigiris. The latter is said to be rare. The Lugger Falcon (*F. jugger*) has not been recorded from the area, though it has been obtained in the Wynaad. Unfortunately Mr. Burgess did not send us the specimen obtained by him for identification. Skins of the larger birds of prey from the South Indian Hill ranges are wanted; the Society would be glad to receive specimens.—EDS.]

In drier tracts, it is seldom if ever met with and is replaced by the Indian Tawny Eagle (*Aquila vindhiana*), a degenerate species so far as eagles go, and the butt of that black bounder, the 'common or garden' crow.

In the United Provinces I have seen this eagle, when on the ground after offal, baited and its tail well pulled by a single pair of Jungle Crows. So much for its aquiline dignity, if it ever had any. In Sind it also stoops to eat offal and I have seen it hanging on to the fringe of a heaving mass of vultures gorging on the carcass of a camel. I have little respect for it, for an eagle it has little majesty, except perhaps when on the wing and then it cannot help itself.

It is at present the commonest eagle in Sind and is, perhaps just as well, seldom met with, where the Imperial, Bonelli's and the Greater Spotted Eagle, truly majestic birds, are found.

Before the construction of river bunds, the Indus when in spate, yearly overflowed its banks, the spill waters flooding more or less well defined tracts and leaving in their wake numerous lakes, some very extensive, which provided the habitat necessary for this eagle.

A great volume of water overflowed the left bank of the Indus and winding through the sand dunes on the eastern borders of the Sukkur district, along the Raini Nai, the Karo Naro and other well defined channels, entered the Eastern Nara and so followed the course of the Hakro, the lost river of Sind, through Khairpur State and Thar Parkar into the Dhoro Puran, which emptied itself into the Runn of Cutch, a few miles west of Rahim-ki-Bazaar.

This mighty volume of water formed numerous dhands on both banks of the main discharge channel, the Eastern Nara, throughout its length of about 276 miles and here in the 'seventies and eighties' Doig found the Greater Spotted Eagle common and believed that it bred in November and December, though he never actually found a nest.

The construction during the past 60 years of hundreds of miles of bunds and extensive canal systems has greatly changed the physical features of these old flood tracts.

Perennial lakes, extensive broads and miles of swamps where wild fowl, snipe and other waders collected in thousands, providing sport, which is now but a recollection, have ceased to exist. The Samaro dhand where Doig found the Large Cormorant (*P. carbo*) breeding in hundreds is now as dry as a bone and the great Makhi dhand, an area of about 20 square miles, in Sanghar taluka, where Bachu 'Badshah' and Piru 'Wazir' two notorious Hur outlaws had their stronghold in 1894, is now just a vast depression, practically the whole of which is under cultivation.

The total extinction of so many large lakes and swamps is undoubtedly the cause of *clanga* not being as abundant now as it was in the days of Hume and Doig.

The scene, however, may again change and perhaps, as far as *clanga* is concerned for the better. The existence now, owing to the Sukkur Barrage, of numerous, great perennial canals must affect in time the fauna of Sind, and perhaps in years to come, when the thousands of trees planted along the banks of the Barrage Canals reach maturity, the Greater Spotted Eagle, a fine bird, will once again come into its own and be as common as it was 64 years ago.

It is still to be met with throughout Sind in riverain and other suitable tracts. I have found it in such localities in every district in Sind, but it is nevertheless, far from common.

On the 1st March 1931 I was walking along the banks of the Mahie canal, near Mir Kosh, about 6 miles from the Indus, in Sukkur district, when I spotted an eagle's nest on a large babul tree. I could see that a bird was seated in the nest. While still about 100 yards away, another eagle was seen making a bee-line for the tree on which the nest was situated. The approaching bird swooped gracefully down and glided over the nest, so low that the bird seated in the nest was able to take easily, what later proved to be a large bull frog, from the talons of the bird in flight, which almost immediately and without apparent effort picked up elevation and speed by a few rapid beats of its powerful wings. It circled round majestically and perched on a large tree about 200 yards from the nest, apparently well satisfied with what it had accomplished. Meanwhile the bird in the nest appeared to be pecking at what had been brought by its mate. On my approach to about 50 yards of the nest it stopped pecking and turned its head in my direction, watching me closely. On my approach still nearer, it stood up in the nest and on clapping my hands flew off, enabling me to identify it with certainty as a female Greater Spotted Eagle.

The male, which remained perched, permitted me to approach within about 40 yards. He was a smaller bird than his mate and from his rich colouring a young adult. While the nest was being taken both birds circled round but made no attempt to attack the climber.

The nest which was placed about 25 feet high, was a fairly large structure of sticks, mostly 'babul' and 'kandi' lined sparingly with dried 'sar' grass and a few stems of 'pan' and 'deer'. It contained a single egg, perfectly fresh, and I believe the first of this Eagle taken in Sind.

The egg was typical of the species, a broad, blunted oval, richly splashed and blotched with pale purple and reddish brown. A very handsome egg and a prize worth securing.

The remains of a Purple Coot, a mud fish, frogs and a Ring Dove were found in the nest and on the ground below.

The nest which was firmly put together was about 30 inches in diameter and 4 inches in depth interiorly.

It was larger than the average nest of the Tawny Eagle. I visited the place about a month later but found no trace of the birds. In December 1933 I came across a pair near Bogar dhand about 5 miles further west, but failed to locate their nest. It is doubtful if they had one, as it was rather too early in the season for them to be breeding.

KARACHI. K. R. EATES.

September 4, 1936. F.Z.S., M.B.O.U.

XIX.—NUMBER OF EGGS LAID BY THE INDIAN SHIKRA [*ASTUR BADIUS DUSSUMIERI* (TEMM. AND LANG.)].

In March 1934 a pair of these birds were frequently seen in my compound and by watching their movements the nest was found on a banyan tree.

When the bird was observed to be sitting three eggs, fresh, were taken on 11-3-34. The birds remained in the vicinity and on 23-3-34 another fresh egg was taken from the same nest. It was thought that this would have ended the female's egg-laying for the season, but on seeing her sitting again on 4-4-34 a further three fresh eggs were obtained. It will thus be seen that this Shikra laid seven eggs within a month against a normal clutch of from three to four eggs.

The average measurement of the eggs was 1.45″ × 1.17″, which shows them to be slightly smaller than the measurements given by Baker and Inglis in *The Birds of Southern India.*

The birds remained in the vicinity until the end of May 1934 but did not lay again.

The same pair it is presumed built again in the compound in 1935 and 1936; the nest in 1935 being on a different tree. In 1936 the same tree as was used in 1934 was selected, the nest being constructed on a different part of the tree.

Although it is September when this note is being written the birds are still seen flying around and cause the smaller birds many anxious moments.

TANJORE. C. H. BIDDULPH.

December 30, 1936.

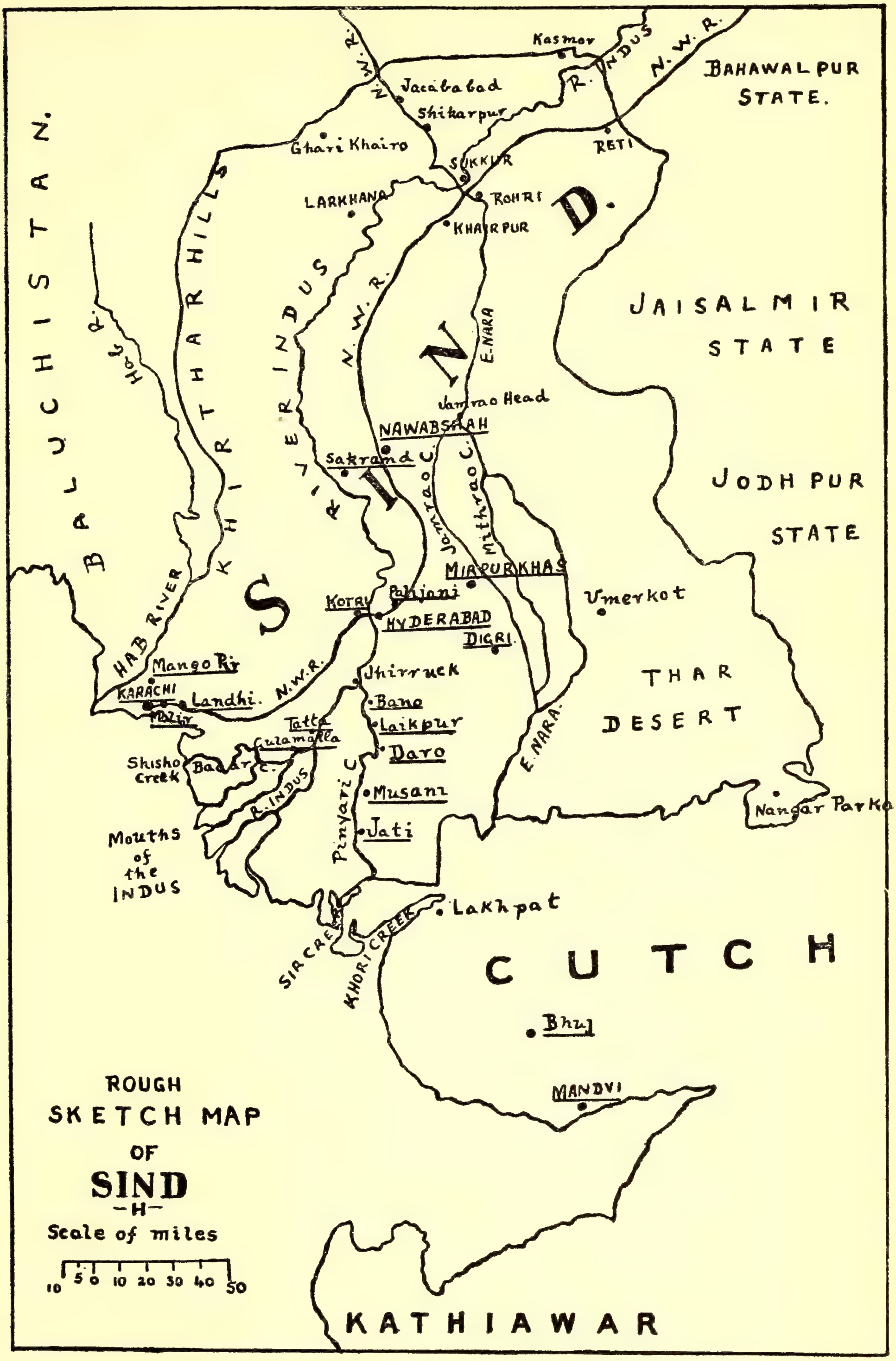
XX.—THE STATUS OF THE KOEL [*EUDYNAMIS SCOLOPACEUS* (L.)] IN SIND.

(*With a map.*)

The status of the Koel in Sind is peculiar. How, and from whence it originally came and established itself in Karachi, situated as it is between desert and sea, has long been a mystery.

It is common and resident in Cutch but between Cutch and Karachi lie some most inhospitable and arid desert tracts, devoid, except where the hand of Man is evident, of all vegetation necessary for the existence of the species, which is arboreal, mainly fruit-eating and as habitat must have large leafed, shady, trees, groves and fruit gardens. The Crow, another factor necessary to its survival is of course as ubiquitous in Sind as elsewhere in India.

The occurrence of a species in any tract of country is accounted for either by natural extension of range or by introduction.


Kasmor
INDUS
R.
N.W.R.
BAHAWALPUR STATE.
N.W.R.
Jacababad
Shikarpur
Ghari Khairo
SUKKUR
RETI
ROHRI
LARKHANA
KHAIRPUR
BALUCHISTAN.
KHIRTHAR HILLS
RIVER INDUS
N.W.R.
SIND.
E.NARA
JAISALMIR STATE
Hab R.
Jamrao Head
NAWABSHAH
Sakrand
Jamrao C.
Mithrao C.
JODHPUR STATE
MIRPURKHAS
Pahjani
KOTRI
HYDERABAD
Umerkot
DIGRI
HAB RIVER
Mango Pir
Jhirruck
THAR DESERT
KARACHI
Landhi.
N.W.R.
Malir
Bano
Tatta
Laikpur
Gulamalla
Daro
Shisho Creek
Baghar C.
R. INDUS
Pinyari C.
Musani
E. NARA
Nangar Parkar
Jati
Mouths of the INDUS
Lakhpat
SIR CREEK
KHORI CREEK
CUTCH
Bhuj
MANDVI
ROUGH SKETCH MAP OF SIND
-H-
Scale of miles
10 5 0 10 20 30 40 50
KATHIAWAR

The Distribution of the Koel [*E. scolopaceus* (L.)] in Sind.

C. B. Ticehurst who energetically worked Sind during the latter years of the Great War remarks, 'its arrival around Karachi whether by natural extension of range or by introduction is uncertain, though the latter seems more likely, as it is still absent from other suitable towns further east.'

He, not unnaturally, arrives at this conclusion because of the fact that the Koel then, had a very restricted range in Sind, and was more or less localised in Karachi and its environs with Malir, about 12 miles distant, as its limit of extension into the hinterland.

Opportunely I was posted to Sind in February 1920 and was thereby enabled to take up observations very soon after Ticehurst left Karachi.

S. A. Strip, a keen naturalist and an accurate observer, tells me that he is perfectly sure that the Koel was not in Karachi in 1875, but that on his return from Kathiawar in 1887 he found it present and to all accounts a permanent resident; E. A. Butler 1879, catalogues the species as a permanent resident in Cutch and Kathiawar, and tolerably common, except in Sind, where it is scarce; Murray 1884, also says that it is common in Cutch and Kathiawar but rare in Sind, where it occurs only during the rains.

In 1885, H. E. Barnes writing on the Birds of the Bombay Presidency says, 'The Indian Koel is very common throughout the district excepting Sind, where it appears to be somewhat rare'.

Later, in 1895, Blanford writing on its distribution in the *Fauna of India* says, 'Rare in Sind and the Punjab and is not known further west. To the eastward it ranges to China.'

E. H. Aitken (EHA), writing in 1907 on the birds of Karachi, lists the species, among others, as a familiar garden bird.

Dr. C. B. Ticehurst, who worked Sind from October 1917 to January 1920, writes in *The Birds of Sind*, 'Ibis', 1922-4:—

'Contrary to general statements of the inhabitants of Karachi, the Koel is resident there and not a hot-weather visitor; its lack of noisiness in winter causes it to escape casual observation.

'The Koel has a very unique distribution in Sind; so far as I am aware it only occurs at Karachi and the neighbourhood, Malir etc. Mr. Gordon informs me that it certainly does not occur in Jacobabad or at Mirpurkhas, nor have I seen it at any of the many places I have visited in Central Sind.

'Doig never met with it in the Eastern Nara, nor Barnes at Hyderabad; Butler writing in 1878, says that it is decidedly rare, and he only saw it once and that was at Hyderabad in June; Butler who was certainly in Karachi for a part of the hot weather of 1877 and 1878, evidently did not meet with it then, and had it been as common there then as it is now, one could not be a day in the Cantonment without hearing it at that season. On the other hand, Hume (1872) stated that it was very seldom seen during his cold weather visit, but Malden informed him he had more than once killed it at Jacobabad. It is fairly common at Mandvi in Cutch.

'It would seem, therefore, that the Koel is a fairly recent arrival around Karachi (it was there in 1907), whether by natural extension of range or by introduction is uncertain, though the latter seems more likely, as it is still absent from other suitable towns farther east.

'It is now excessively common both in the Cantonment and in the Lyari Gardens; it begins calling at the end of the third week in February, and its incessant and monotonous voice can be heard from then to well on into September, occasionally in October or even early November, after which date it becomes inconspicuous and retiring.'

E. C. Stuart-Baker, *Fauna of India*, 1927, writing on its distribution says that it is rare in Sind and the Punjab while Hugh Whistler, 1935, says that in Sind it is only locally common; lastly I think it very necessary to mention that Douglas Dewar writing in the *Journal of the Bombay Natural History Society* 1908, on the migration of certain species, says, 'There is not the least doubt that it is merely a summer migrant to Lahore.

'Not a Koel is to be seen in that place between the end of October and the middle of March, but throughout the hot weather it is exceedingly abundant.'

The foregoing is a summary of the information I have been able to collect on the distribution of the Koel in Sind prior to 1920, on observations made by ornithologists such as Hume, Scrope, Doig, Butler, Barnes, E. H. Aitken, Frank Ludlow and Dr. C. B. Ticehurst.

My own observations in Sind now cover an unbroken period of 16 years and include the whole of the Province with the exception of the Khirthar mountains and the southern and eastern portions of the great Thar desert, regions to which the Koel is never likely to venture, even as a straggler.

On demobilisation in February 1920, I was posted to Karachi and during the course of a couple of years found the species common, a permanent resident and breeding freely in Karachi, Malir and Landhi.

Between 1920 and 1928 I took many crow's nests, some containing as many as six eggs of the Koel, and sent Stuart-Baker a series including the eggs of the foster parents in all cases the Sind House Crow.

Up to the winter of 1928 the Koel certainly did not extend, as a permanent resident, beyond Landhi, about 15 miles distant, eastward of Karachi and northward beyond the trans-Lyari Sewage Farm, as I failed to locate it at Mangho Pir and also never found its eggs there, though I examined several years in succession, numerous crow's nests around Mangho Pir and at Dharmao further north, where numbers of house crows breed regularly.

On my return to Karachi in 1936, I discovered that it had found its way north to Mangho Pir, where it had permanently established itself.

I did not meet with it at Kotri, Hyderabad or Badin in the summer of 1922, nor again in Hyderabad in March 1929, or further north at Matiari, Sekhat, Khebar, Hala or Saidabad in March and April the same year, but in June 1934, from the 16th to the 30th, I found it common and breeding at Kotri, Hyderabad and Palijani, about 18 miles north of Hyderabad.

I was stationed in Sukkur from the 10th January 1930 to the 4th February 1934, and failed to find it anywhere in the district, though there is suitable habitat at Sukkur, Rohri, Pano Akil, Ghotki, Chak, Shikarpur and many other places.

On the 1st June 1933 I thought I heard a bird call once, in the mango and date gardens on the Rohri banks of the Indus. I failed, however, to locate it and after again visiting the spot the following day and going through about 3 miles of mango and date groves, in the broiling heat of a June sun, without hearing or seeing a bird, I was convinced that I had mistaken the shrill *ko-ee* of small boys, who were about the gardens keeping off crows, minas and babblers, for the familiar *ko-e-o* of this bird. As crows were nesting in some numbers in the mango and date groves, any koels in the locality would assuredly have made known their presence during the course of the afternoon and evening I spent there.

In Bahawalpur State, which borders Sukkur district on the north, not a bird was seen or heard during a three-days' visit to Bahawalpur in late March 1933.

Similarly in Khairpur State, south of Sukkur I failed to meet with it anywhere, though most suitable localities exist, during the course of frequent hot weather visits to the State in 1930 and three succeeding years.

At Larkhana, on the southern border of the Upper Sind Frontier district, I failed to come across it, during short visits in July 1933 and August 1934. Young crows though everywhere much in evidence, the majority just able to fly and still being fed by the parent birds, koels, either adult or young were conspicuous by their absence and were nowhere to be found.

Malden informed Hume in 1872 that he had more than once killed it at Jacobabad, in the Upper Sind Frontier district, but this I feel sure is a case of mistaken identity, to use police parlance, and that the birds killed by Malden were in reality Pied-crested Cuckoos, which are common in Jacobabad during the hot weather. On the other hand Gordon, now Chief Engineer in Sind, informed Ticehurst that it did not occur in Jacobabad.

To the correctness of this I can fully testify, as I was stationed at Jacobabad from July to middle November, 1934 and found it totally absent, not only in Jacobabad itself, which is well wooded, but throughout the length and breadth of this district. During many wanderings beween Ghari Khairo and Kashmor and in suitable localities along the Desert and Begari canals, during July, August and September though I came across numbers of young crows still under parental care and in July found some birds still on eggs or rearing callow young I failed to find any trace whatever of the Koel. If, as Malden said, the bird was found in Jacobabad more than once then, there is no apparent reason why it should not still be found, not only in Jacobabad but in the adjoining districts of Sukkur and Larkhana also, where there is suitable habitat and fruit trees aplenty, in the way of mango, pipal, bar, date, guava, fig, papia and mulberry, all suitable to the palate of the Koel.

In Mirpurkhas, Thar Parkar district, I failed to find it during the summer of 1922, but on my return there in January 1936, I found it abundant and extending south as far as Digri, 38 miles distant. In January, February and March the same year I did not succeed in coming across it further eastward and failed to locate it at either Samaro or Umarkot, the city of the desert, on the edge of the wonderfully fertile Nara valley, where there is suitable environment almost everywhere and much in the way of Koeline fruits.

At Mirpurkhas and Digri I found it common and frequently saw both sexes feeding on pipal and bar (banyan) berries in company with bulbuls, mynahs, tree-pies and crows. In the former place I both heard and saw birds daily, when in headquarters between the 4th January and the 23rd March and am authoritatively informed that it is now a resident species and breeds, laying its eggs as usual in the nests of crows.

In Nawabshah the headquarters of the district, I found it common and quite noisy on my arrival there in April 1935 and daily, as is its wont, it became more, and more noisy and irksome as the heat increased and the breeding season of the crows approached.

The species in Nawabshah itself is a permanent resident and breeds in June and July.

The presence of bar, pipal and nim trees in the official residential area and mangoes, guavas, figs, and grapes in most gardens, which provide food and leafy shelter for the birds all the year round, is undoubtedly the cause of it now being a regular resident. It certainly extends, as a straggler at all events, as far south-west as Sakrand, 12 miles distant, where I met with a young male, fully fledged and well able to fly, on the 9th October 1935, though I failed to find it on the 6th April 1929 when I was at Sakrand for a day and again in May, June, July, November and December, 1935.

I did not succeed in locating the bird further north in Nawabshah district during the summer of 1935, though there is most suitable habitat and much summer fruit available around Abji, Mithiani, Darbelo and Tharushah, where mangoes, figs, dates, pipal, bar and oranges grow in abundance, in extensive gardens and groves on the banks of the Nai Lakho canal and where crows of course, a very necessary factor, are common and breed in great numbers.

From April to the end of December 1935, excepting the one occasion in October when I came across a lone bird in Sakrand, I failed to find it anywhere outside of Nawabshah itself and am confident that at present, the species, as a permanent resident, is restricted to the limits of the residential area in the immediate viciniy of Nawabshah.

In Karachi district in 1934 I was not surprised to find it at suitable places along the Pinyari canal, which takes off from the left bank of the Indus below Jhirruck and enters the Sir creek below Jati, also called Mughal Bin, after flowing a southerly course of about 73 miles through the talukas of Mirpur Bathoro, Sujawal and Jati. It has 33 branches totalling 240 miles in length and over 3,000 distributaries, and practically irrigates the whole of Mirpur Bathoro and Jati, and a part of the Sujawal taluka.

At Mughal Bin the Gadap and Sher Khan *wahs* take off and flow in a south-easterly direction, while the Hajia and Saida *wahs* take off and flow roughly south-west. The Sher Khan *wah,* which flows towards Cutch and tails off into a branch of the Sir creek, has a total length, from its head at Jati, of about 40 miles.

In late March and April 1934 I more or less followed the course of the Pinyari canal from Bano, 2 miles below its take off from the Indus, to Jati, below which it enters the Sir creek, the middle and lower reaches of which divide Cutch from Sind, and found the Koel in gardens and groves at Bano, Laikpur, Daro, Musani and Mughal Bin. At Daro an old Cutchi mali, who had been there some years told me that the bird was well known and common in Cutch and that he had seen it at Daro, during the hot weather only, for several years in succession.

They arrived, he said in March or April and left in September.

Crossing the Indus at Sujawal in April the same year I found the bird fairly common and quite noisy at Tatta, and in March 1935, the year following, I met with it at Ghulamalla, on the bank of the Baghar canal, which in 1817 was the main channel of the Indus to the sea.

It takes off from the right bank of the Indus a few miles below Tatta and enters the Shisha creek after flowing a circuitous course in a generally westerly direction of about 90 miles. The village of Ghulamalla, where there is suitable habitat, is about 12 miles south-west, as the crow flies, of Tatta. Here again the mali, an old Purbia from the United Provinces, where the bird is common and only too well known, informed me that koels came there every hot weather and remained in the gardens till after the rains.

I left Tatta on the 15th April 1934 and at Jhirruck 42 miles up-stream failed to meet with it between the 15th and 17th, though conditions were suitable in the way of mango groves and fruit gardens growing guava, mulberry, fig and pipal.

Further south and south-west at Sujawal and Mirpur Sakro, where conditions are not so favourable I failed to meet with it in May and June 1934. At Malir, a distance of about 50 miles as the crow flies from Tatta, in February 1935, it was common, and seen and heard daily from the 12th to the 20th. Similarly in Karachi it was seen and frequently heard, early mornings, in December 1934 and January and February 1935.

As the hot weather approaches it becomes more and more noisy, and now in June (1936), birds are everywhere splitting the air, each trying to out-shriek the other, with their incessant cries of '*who-are-you*'.

Lastly in May 1936, I paid several visits to Mangho Pir, 10 miles directly north of Karachi where I failed to find it from 1923 to 1928, and both heard and saw the bird frequently. In late June the same year I found several crows' nests containing eggs of the koel in the gardens on the Gadap side of the hot springs, where dates, mangoes, guavas and papias are grown, and a local Mekrani informed me that the bird had been resident there for the past 3 or 4 years.

The continued observations of Dr. Ticehurst and myself extending over a period of about 20 years, have resulted in the collection of most interesting data regarding the status and distribution of the Koel in Sind.

It is evident that in 1920 the species was only locally common and occurred as a permanent resident only at Karachi and eastward as far as Landhi, about 15 miles distant.

Elsewhere, it was met, if at all, as a rare straggler and then not beyond the northern and eastern boundaries of Hyderabad district.

It is now, 16 years later, common and resident as far north as Nawabshah and north-east as far as Mirpurkhas. It naturally cannot extend south and due west of Karachi, nor will it ever extend north-west into Baluchistan.

My discoveries have convinced me that its presence in Karachi cannot be accounted for by introduction as firstly, the species, contrary to popular practice in the United Provinces, is never caged and secondly, for it to be commonly caged it must necessarily occur as a permanent resident elsewhere in Sind and this, as established by this paper, is definitely not the case, the hypothesis therefore that its occurrence in Karachi is due to introduction must fall through.

The only other theory which can be put forward is the natural extension of its range and this I believe to be the real reason for its occurrence in and around Karachi, where for years it has been localised as already mentioned.

Now the point left for decision is whether it originally came to Karachi from the Punjab or from Cutch.

We have it from a reliable observer like Douglas Dewar that the bird up to 1908 was merely a summer migrant to Lahore. Similarly H. Whistler writing in the 'Ibis' on the birds of the Jhelum district (1916) and the Rawal Pindi District (1930) records it as a hot-weather visitor from April to October. It is thus clear that the bird is a summer migrant to the Punjab.

If we contend that it came to us from the Punjab, we must admit that the only route by which it can reach Karachi is by following the course of the Indus as far as Hyderabad or Tatta.

If it did this orginally, there is no earthly reason why some birds at least should not continue to do so now, particularly during the hot weather, and any birds taking this route, like the Pied Crested Cuckoo, must necessarily pass through Upper Sind and follow the course, down-stream, of the Indus through Khairpur State and the districts of Larkhana, Nawabshah and Hyderabad, yet during my long stay of four years in Sukkur District and subsequent visits to Bahawalpur, Upper and Central Sind, I found it everywhere totally absent, in spite of being continually on the *qui vive* for it, and did not fall in with it as far north as Hyderabad till 1934, though apparently it had established itself there a few years previously and had obviously migrated there from Karachi District, and extended from there north as far as Nawabshah, and east as far as Mirpurkhas, which so far as I am aware is at present the limit of its extension north-east, though it will in all probability extend in time to the Nara valley and the tracts drained by the Jamrao and Mithrao canals where there is suitable habitat.

Since I failed to meet with the species anywhere north of Nawabshah during the course of six consecutive summers, in spite of the long existence in this tract of many suitable localities where the species could easily have survived I have no hesitation in recording that the Koel has not entered Sind from the Punjab.

Let us now consider the alternative route from Cutch which is separated from Sind by the Sir creek south of Jati.

As previously stated I found the bird in March and April 1934, on the left bank of the Indus, in Karachi district, along the Pinyari canal, from Jati to Bano and along the banks of this canal and in the tracts drained by it are to be found numerous mango groves, and in most large villages pipal and bar trees and gardens growing mango, guava, papia and fals and in some places date and mulberry, which provide the Koel with food and the environment necessary for its existence on passage as a migrant. Similarly on the right bank of the Indus at places where there is suitable habitat I found it, at Tatta and Ghulamalla.

Now the only intervening tracts on this route presenting any kind of difficulty in respect of habitat, lie between the limit of its extension north-west of Cutch Mandvi and Jati and between Tatta and Landhi. The distance, as the crow flies, from Cutch Mandvi to Jati is about 130 miles, while that from Tatta to Landhi is only about 45 miles.

These intervening spaces admittedly embrace in one case a saline desert, with the barest scrub and coarse grasses the only vegetation and in the other, a waterless waste, except in the rains, of sand and desert scrub with no groves of leafy trees, yet the distances in both cases are not so great as to prevent the Koel, a strong flier, from crossing these inhospitable broken links in the chain in a few hours. The presence of the bird in the hot weather along the Pinyari canal on one hand, and its total absence on the other, north of Nawabshah, is I think sufficient proof that it does cross these broken links in the chain of suitable habitat between Cutch and Karachi and arrives in Sind from Cutch.

I believe that roughly its route of migration into Sind is from Cutch to Jati, from whence it follows the course of the Pinyari canal to Daro and Bano, about where it crosses the Indus to Tatta and thence to Landhi, Malir and Karachi.

Thus I think that the mystery of the occurrence in Karachi of the Koel has at last been solved and its extension over Sind from south to north, which is undoubtedly taking place, should during the course of the next decade prove of great ornithological interest.

KARACHI,
July 2, 1936.

K. R. EATES,
F.Z.S., M.B.O.U.

XXI.—THE DISTRIBUTION AND NIDIFICATION OF THE LARGE INDIAN PAROQUET (*PSITTACULA EUPATRIA NEPALENSIS* [HODGS.]) IN SIND.

Alexander the Great after conquering the Punjab in 326 B.C. sailed down the Indus into Sind, where he made extensive explorations.

On his return to Europe he took back specimens of this Paroquet, which was incidentally named after him by, I think, Linnæus. It is not definitely known however, whether the birds taken to Europe were from Sind or the Punjab. Jerdon records that, doubtless it was taken from the Punjab, where it is common, while EHA commenting in the *Sind Gazetteer* on the subsequent change of its specific name from *alexandri* to *nepalensis* writes that, it is now named *nepalensis* in contempt of Alexander the Great, who took the species back with him from Sind. As I was neither in Sind nor the Punjab in 326-325 B.C. I prefer to keep out of the controversy, though I must say that from my knowledge of its present distribution in Sind, I think that Jerdon is nearer the probable.

Nepalensis is fairly common in and around Karachi where it is resident and breeds in chimney stacks, roof eaves and suitable trees preferably, the cocoanut palm.

Stuart Baker records that Bulkly obtained its eggs near Karachi in 1881. The majority of birds kept in captivity however are not locally obtained but are brought down from the Punjab as fledglings and hawked for sale in the streets of all large towns at anything from 8 annas to 2 rupees a bird. It is of course common in the Punjab and I have frequently come across it near Kot Sabzal, in Bhawalpur State (Punjab) about 3 miles from the Sind border.

Ticehurst writing in the *Ibis* 1923, considers that Karachi birds are the descendants of escapes, as there were no certain records of it down to 1886 and because it had not been found outside of Karachi.

As this paroquet is a favourite cage bird in Karachi it *is* likely that some of the Karachi birds are the descendants of escapes, but not all, as Ticheurst was not aware that it was abundant, though very local, in parts of Upper Sind, whence it has probably found its way south to Karachi.

In Sukkur district, where I was four years, there is more or less a regular, north to south, cold-weather migration from about November, the birds moving as far down as Kandhra, 8 miles below Rohri and about 70 miles from Ubauro, on the northern boundary of Sind, where it is resident and abundant.

Birds in couples and small flocks, apparently strays from this movement, have been met with as far south as Nawabshah, whence they doubtless find their way to Karachi, as when in couples or small flocks away from their strongholds in the north of Sind, they are relentlessly pursued and kept on the move by their smaller cousins, the Rose-ringed Paroquet (*Palæornis torquata*) which swarms throughout the Province.

It is therefore not unlikely that the colony in Karachi is added to frequently by strays which find their way south from Nawabshah, a distance of about 125 miles as the crow flies.

I do not think that the birds met with in Nawabshah district could have been from Karachi as I have not met with this Paroquet anywhere in the intervening district of Hyderabad or beyond Landhi, 15 miles east of Karachi, though there is suitable habitat, both east and west of the Indus in Karachi district from Jhirruck to Ghorabari.

I first came across it on the 10th May 1930 at Ubauro, in the north of Sukkur district about 8 miles from the Punjab border. The birds were very plentiful and I noticed numbers of young flying about with adult birds. In June the same year I was again at Ubauro and the birds were just as plentiful.

In November I found them fairly common at Mirpur Mathelo about 15 miles south west of Ubauro and in December a few birds were seen around Ghotki about 14 miles south of Mirpur Mathelo. On the 11th December 1930 I again had to visit Ubauro and found many birds paired off and courting.

Two nests were located on the 12th December, both in simal (silk-cotton) trees. In one the female was seated inside the entrance with her head out. The nest contained a few feathers. In the other the male was inside the nest. Both nests were apparently ready for eggs. Want of time prevented me from searching for other nests on this occasion, but on my again visiting the place on the 21st January 1931, I was able to continue my observations for several days without interruption.

The town of Ubauro situated 9 miles north west of Daharki, the nearest Railway Station on the main line to Lahore, dates back to about A.D. 987. Sometime later it was fortified and surrounded by a moat, the north and south entrances to the town being crossed by substantial brick bridges, which still exist, though some of the spans are crumbling and numberless bricks from the main structures have been taken away and used by the townsfolk for building purposes. These moat bridges are now the homes of spotted owlets, house sparrows, pigeons and some rose-ringed paroquets.

On the outskirts and in the town itself are many great siris, pipal, lai and talli trees which provide ideal nesting places for the Large Indian Paroquet. Outside the town are several very old gardens growing bhan (white poplar), simal, pipal, siris, mango and date trees, where also this paroquet is provided with suitable nesting sites.

The roads approaching the town are lined with siris, lai, babul and khandi trees, but these, as nesting places are appropriated mainly by the smaller species, which seldom ventures to breed in the preserves of its larger and stronger relative.

On the 21st January 1931 I examined 14 nests. All except two contained young, mostly callow. One nest held 3 young and an egg on hatching point and the other, two young and an addled egg. The day following 17 nests were examined. All with the exception of one, in which there were two fresh eggs, contained young. On the 23rd a further 5 nests were examined and all contained young except one, which had 4 well incubated eggs.

In February I was again able to visit the locality and found, from the 10th to the 14th, six more nests all of which, strange to say, contained eggs, apparently a late laying.

On the 15th I visited Khumbra, a fairly large village on the Dahar canal about 12 miles north of Ubauro, a few miles from the Punjab border and there found this paroquet breeding in fair numbers on siris, pipal and talli trees in and around the village. I examined about half a dozen nests, all of which contained either young or well incubated eggs.

On the 23rd February I paid a flying visit to the Ubauro colony and found numbers of young birds well able to fly. The day following I was at Mirpur Mathelo about 15 miles south west of Ubauro and met with about a dozen adult birds during the few hours I was there. The year following, when at Mirpur Mathelo from the 10th to the 16th December, I found a few birds breeding in pipal and siris trees around the environs of the town. At Ubauro, where I encamped from the 18th to the 23rd of the same month, breeding was in full swing.

On the 26th June 1932 I came across a single adult male at Mirpur Mathelo and between the 19th and 23rd July, met with it for the first time at Pano Akil about 28 miles further south, where I daily saw about a score of birds.

From the 9th to the 13th November 1932, I daily came across this paroquet in small flocks at Kandhra, 9 miles south of Rohri, on the borders of Khairpur State and on the 14th of the same month found several pairs preparing to breed in holes in siris, lai and bhan trees on the Ghotki-Adilpur road, about 28 miles south of Ubauro, the stronghold of this species in Sind.

When I was posted to Karachi in 1920 this paroquet though locally common had not apparently extended east to Malir, where it has since established itself. I was encamped at Malir from the 12th to the 20th February 1935 and daily saw several birds in the fruit gardens, where it was always to be found in cocoanut groves.

On the 27th October 1935 I came across a single pair of birds in a mango tope on the banks of the Nai Lakho canal at Tharushah, Nawabshah district. The birds were being given a rough passage by the smaller species, which swarmed everywhere and gave them very little peace. They remained in the locality several days and then disappeared. Although I had paid Tharushah several visits previously and had thoroughly explored the numerous and extensive fruit gardens in the locality I had never before come across this paroquet, whose distinctive call, which it oft repeats both on the wing and when perched, cannot be mistaken.

Exactly two months later on the 27th December 1935, a small flock of about five birds visited Nawabshah and were given a very rough reception by the smaller species, which swarmed in hundreds and literally mobbed the minority, singled out individuals and chased them from tree to tree. The day following not a bird was to be seen. Whether they continued south and reached Karachi about 125 miles distant or returned north to again meet with persecution till they arrived within their own domains in the extreme north of Sukkur district, is a matter of conjecture.

In Sind it is an early breeder and commences to lay quite two months ahead of the smaller species. In several instances two and even three nests were found in the same tree. In many cases birds used old holes but quite a few had been freshly cut out by the birds themselves. Nests were placed from 12 to 40 feet high and some contained a few feathers besides the usual small chips of wood. The full clutch of eggs laid is four and the period of incubation about 16 days.

The courting antics of this paroquet are quite as grotesque and amusing as those of its smaller relative, the Rose-ringed Paroquet and to watch a wooing would, I think, even interest a cockney of my acquaintance, whose sum knowledge of birds was, that they, 'was fings wiv fevvers, some yer can heat and some yer carnt'.

In Karachi a favourite food of this paroquet is the dried seed of the casuarina, while in Upper Sind it is partial to the seed and tender shoots of the white poplar, lasora and nim berries, and the beans of the siris and talli.

I have occasionally seen it feeding on the ground in small flocks on dried nim berries during November and December. Unlike its smaller relative it is, in Sind at any rate, not destructive to standing crops.

The smaller species plays havoc with standing wheat, juar and bajri wherever it occurs and I have frequently seen it in scores on wayside railway platforms feeding on bagged wheat, much of which is wantonly wasted as the bags are bitten through and the grain strewn all over the place. What is not appropriated by the railway menial staff is devoured by pigeons, doves, mynahs and squirrels.

In Sukkur district *nepalensis* is known as *Takru*, literally meaning 'of the hills'.

Residents of Ubauro and Khumbra and Seraikis of the border informed me that this bird had been resident there for generations and that it had been known as *'Takru'* from time immemorial. They believe that it originally came from the hills. What hills, they cannot say. This of course is merely conjecture, as there are no hills in Sind where this paroquet could be resident. The species has obviously extended to Sind from the Punjab, where it is abundant.

At present it is only resident in the extreme north and south of the Province, in Sukkur district and around Karachi. I have met with it nowhere else, except as a straggler and then only in Nawabshah district.

The Rose-ringed Paroquet, except in the desert and Kohistan tracts, is extremely common everywhere and since there is suitable habitat and much in the way of parrot food in districts where *nepalensis* is at present absent, it is not unlikely that the existence now of great perennial canals, both east and west of the Indus, will in time result in the extension of its range to that of *torquata,* which has at present, more or less the monopoly of the Province.

KARACHI,
October 2, 1936.

K. R. EATES,
F.Z.S., M.B.O.U.

XXII.—THE CEYLON HOOPOE (*UPUPA EPOPS CEYLONENSIS* REICHB.).

Mr. Salim Ali in the fourth part of his admirable Ornithology of Travancore and Cochin in the *Journal* of 1st December appears to be in some doubt as to the local movements in the hills of the Ceylon Hoopoe.

While not actually in the territory of the survey, the area of the Anamallai Hills under tea, coffee and other cultivation is near enough to be typical of the area covered at about 3,500 ft. elevation and in the evergreen biotope. Ater a period of seven years' study of the Avi-fauna of the district a few observations of the movements of this bird may be of interest.

To start with the South West Monsoon period of from the latter end of May to the end of August and sometimes well on into September, the bird is not found, though if September be unusually fine, towards its latter end a pair or two may be seen—I saw a pair this last September on the 24th, but they usually go down to drier climes on the outbreak of the N. E. Monsoon in October, and stay till it is over returning in ones and twos sometimes as early as December, though usually about the middle of January. I saw a single bird on the 9th of this month. During February, March and April they become increasingly numerous and may be seen in pairs on any road and heard calling the familiar 'hoop-po-po' mostly during the hottest part of the day. Adults and young fully fledged may be seen at the beginning of May but all disappear with amazing suddenness at the first showers, forerunners of the approaching monsoon.

NADUAR ESTATE,
VALPARAI P.O.,

R. N. CHAMPION-JONES.

XXIII.—NOTE ON THE SANDPIPERS IN THE PATNA DISTRICT, BEHAR, RECORDING THE OCCURRENCE OF THE AVOCET SANDPIPER, THE CURLEW STINT AND THE BROAD-BILLED STINT FROM INLAND LOCALITIES.

The following is a list of the Sandpipers taken by me in the Patna District recently, whilst investigating the birds of this place. It may prove of interest as some sea-shore and estuarine forms are recorded far inland. The date in brackets indicates the earliest date on which the birds were seen:

Numenius arquata orientalis, Brehm. The Eastern Curlew. (7th September).

Numenius phaeopus, Linn. The Whimbrel. (7th September).

Limosa l. limosa, Linn. The Black-tailed Godwit. (10th August).

Limosa l. melanuroides, Gould. The Eastern Black-tailed Godwit. (7th October).

Limosa l. lapponica, Linn. The Bar-tailed Godwit.

The above birds are met with on the Ganges as well as on inland jheels.

Terekia cinereus, Gulden. The Avocet Sandpiper. (11th September).

A specimen was obtained from a local bird-catcher on 11-9-36 and another seen with the same man on 10-10-36.

Tringa ochropus, Linn. The Green Sandpiper.

Common on inland jheels, less so on the Ganges.

Tringa stagnatilis, Bechstein. The Marsh Sandpiper. (26th August).

Common on inland jheels, less frequently met with on the Ganges. This bird should be removed to the genus *Glottis;* the pattern of its plumage is very similar to that of the Greenshank and its bill is also upturned.

Tringa hypoleucos, Linn. The Common Sandpiper.

Only noticed on the Ganges where it is usually solitary.

Tringa glareola, Linn. The Wood Sandpiper. (26th August).

Plentiful both on inland jheels and on the Ganges.

Tringa t. totanus, Linn. The Redshank. (26th August).

Very common on the Ganges where it is sometimes met with in very large flocks, also observed on the jheels.

Tringa erythropus, Pallas. The Spotted Redshank. (26th August).

Frequently taken on inland jheels, rarely observed on the Ganges.

Glottis nebularia, Gunn. The Greenshank.

Extremely common on the Ganges, also seen on jheels.

Philomachus pugnax, Linn. The Ruff and the Reeve. (26th August.

The number of these birds which are hawked about by bird-catchers is enormous; they are found in very large flocks on jheels. I have never noticed them on the Ganges. These birds are most variable in colouration and I have collected about eight different phases in plumage but none had ruffs.

Erolia m. minuta, Leisler. The Little Stint. (27th August).

Very common both on the Ganges and on jheels; many birds were in summer plumage on arrival.

Erolia temminckii, Leisler. Temminck's Stint. (10th October).

Common on jheels, less on the Ganges.

Erolia testacea, Pallas. The Curlew Stint. (8th September).

A few specimens taken on jheels.

Erolia a. alpina, Linn. The Dunlin.

Taken on the Ganges only.

Limicola falcinellus sibirica, Dresser. The Eastern Broad-billed Sandpiper. (8th September).

A few specimens taken on jheels.

Capella g. gallinago, Linn. The Common Snipe. (29th September).

A few taken on jheels.

GULZARBAGH,
PATNA.
December 19, 1936.

E. A. D'ABREU, F.Z.S.

XXIV.—SARUS FLOCKS.

A letter on this subject appeared in your August issue. I have noticed that Sarus Cranes flock together in India (Rajputana) and in Burma (Karenni), but if I remember right they only do so at a certain season of the year—in March and early April. I have put such gatherings down to an annual, matrimonial gathering where and when the young birds are given the opportunity of meeting their kind and advice that parents usually offer to their children on such occasions. I believe such marriage marts are held in the case of other species of cranes and any information on the subject from naturalists who can tell us about them would be most interesting. Does not a certain amount of dancing take place before the debutantes?

TAUNGGYI, S. SHAN STATES.
September 30, 1936.

T. R. LIVESEY.

[Sarus Crane are usually found in pairs or accompanied by one or two young. Occasionally these crane collect in flocks, but whether in large or small numbers, the birds are always in pairs each pair acting independently of other pairs forming the flock. Such congregations of Sarus, it is explained, are due to the birds collecting in dry weather or seasons of drought, in the few localities where water is available. The monsoon sees their dispersal. In Hume and Marshall's *Game Birds of India* there is an interesting note by Mr. Davis who observed flocks of Burmese Sarus (a racial form with identical habits) in the month of August in mid-monsoon. He saw several flocks of these birds in the *khendas*, 12 miles north at Thatone. They varied in number from 8 or 10 to fully 60, and contained birds of both sexes. The appearance of these birds in large flocks early in August, and the fact that Dr. Anderson had also observed large flocks passing overhead at Prome, apparently migrating, led Hume to enquire whether the species is not to a certain extent migratory in Burma. Numbers of the Upper Burma birds, coming south near the Gulf of Martaban to breed? There seems to be little doubt that conditions of water and food cause Sarus to congregate in favoured areas, but whether Sarus are locally migratory in India or Burma and whether the birds congregate before migrating is a point which requires further observation.

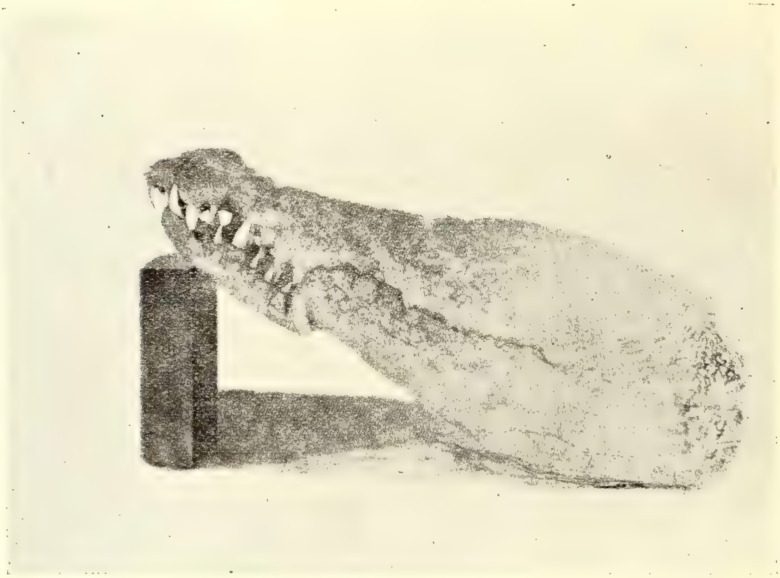
The common Crane (*Megalornis grus*) and the Demoiselle crane (*Anthropoides virgo*), both species in which the tribal instinct is more strongly developed and which usually gather in great flocks, arrive at their breeding grounds in flocks of two to three hundred individuals. About the second week after arrival, the flocks break up into pairs, which disperse all over the country, but even when so dispersed, the birds were observed to reassemble in the morning and evening and go through those curious antics described as dancing. The Sarus indulges in similar exercises but never in assemblies. Captain Butler says that in the breeding season two old birds may be seen engaged in a kind of 'nautch', they spread their wings and lower their necks until they look like two game cocks about to fight; then all of a sudden they raise themselves and begin to dance, trumpeting loudly all the time. Then one or the other springs high into the air descending again to perform the same absurd antics.—EDS.]

XXV.—A MUGGER (*CROCODILUS POROSUS*) WITH A BROKEN LOWER JAW.

I enclose a photograph of the skull of a mugger measuring 5 ft. 10 in. in length which I shot in September 1936. It will be seen that the lower jaw on the left side had been broken and displaced causing the jaw to twist to one side. The result was that the teeth of the lower jaw on the other side came in contact with the palate and had formed small sockets in which they rested.

The skin covering the jaw had evidently been cut through but had healed, leaving a lighter line which can be seen in the side view of the head.

The head was boiled to examine the bones near the break and it was found that the broken ends of the jaw had been joined by a new growth of bone which had a spongy appearance. It appeared that the injury may have taken place only a few months previously as the join in the bones opened out due to the boiling. The mugger was in normal condition.



While on the question of injuries noted on crocodiles it may be of interest to record that Mr. C . V. Stephens, Executive Engineer, P.W.D., Tanjore, shot a crocodile measuring 9 ft. 7 in. in September 1936 with the right front foot missing from above the elbow joint. The injury was an old one and had quite healed, the crocodile being in good condition and in no way handicapped by the loss of almost the entire limb.

With my previous note No. XXVII on page 184 of vol. xxxix, No. 1, of the *Journal* and the Editor's note on the same article it is observed that there are now three recent records of crocodiles with missing right fore feet and it raises an interesting point as to how the right fore leg appears to be injured in each case and the cause.

If the loss is due to fighting it seems to point to the fact that a favourite grip must be by the fore legs which are damaged in consequence.

It would be of interest if members recorded instances that are known to them of crocodiles with similar or more serious injuries.

TANJORE, C. H. BIDDULPH.

December 30, 1936.

XXVI.—NOTES ON THE POND TERRAPIN (*GEŒMYDA T. TRIJUGA*) IN SALSETTE ISLAND.

During the early part of the monsoon, I obtained two female specimens of *G. t. trijuga* through Mr. H. Ali. Both specimens were caught at Andheri. This species is apparently common on the island, but is seldom seen on account of its nocturnal habits. During the rains they wander about much at night.

Both the specimens referred to I kept in captivity. During the early part of October, I cast one of them for the Museum. When opened it was found to contain numerous eggs, the largest of which were about 1.5 cm. in diameter and quite spherical. On the 20th of the same month, the surviving terrapin laid five eggs in her cage, early that morning. The five eggs were laid in fairly quick succession. The two largest measured 48 x 26 mm. each, the next in size 46 x 27 mm. and the remaining two 44 x 26 and 44 x 25 mm. respectively. These measurements agree fairly well with those given in the *F.B.I.* (new ed.) Reptilia, for the race *G. t. thermalis* from Ceylon.

The eggs are elliptic, narrowing down slightly towards the poles. Both the poles are equally domed. The shell is firm and calcarious, white, with a slight pinkish tinge.

With regard to food, I am of the opinion, that this species is entirely vegetarian. The captives, referred to, refused to take meat of any kind, but would always readily take such vegetable as tomatoes, and cucumbers (they were very partial to the latter), but would not eat pumpkins. They would occasionally eat boiled rice from the dog's plate.

These creatures appear to be very docile, never attempting to bite or to fight among themselves, though sometimes one would snap at the other over food. The two lived on amicable terms with a Star-shelled Tortoise (*Testudo elegans*) in the same cage.

The scent glands in this species are well known, and I can only confirm this. When very agitated these terrapins emit a very powerful and disagreeable stench—presumably a means of defence.

Bombay Natural History Society,
Bombay. C. McCANN.
October 25, 1936.

XXVII.—NOTES ON THE BREEDING OF THE RAT-SNAKE OR DHAMAN (*ZAMENIS MUCOSUS*)

Col. F. Wall referring to the breeding of the Rat-Snake (*Z. mucosus*) in his interesting serial published in the *Journal* entitled, 'A Popular Treatise on the Common Snakes of India' (vol. xiii, p. 268), remarks that the periods of gestation and incubation are unknown to him, yet he gives the periods of deposition of the eggs and hatching with fair accuracy.

On several occasions I have observed these snakes in copulation during the months of April, May and June. Specimens dissected in June and July have had eggs in the uterus. On the 11th August this year (1936) eleven eggs were taken a few inches under the soil. The number of eggs for this species as recorded by Col. Wall is between nine and fourteen. The eggs were in the shape of a long ellipse with both the poles equally domed; chalky white and non-adherent. (Wall: 'The eggs laid in adherent clusters and deposited, I believe, in holes in the earth. They are white, glossy and parchment-like, with the poles equally domed.') The largest egg measured 50 × 25 mm. and the smallest 43 × 24 mm.; the others were all in the neighbourhood of 46 × 26 mm. These measurements agree well with those recorded by Nicholson ($2'' \times 1\frac{1}{4}''$).

On opening one of the eggs I discovered that it contained an embryo about seven to ten days old. The remaining ten eggs I kept in a desiccator with a little water at the bottom, while the eggs rested on a tray above. At intervals I opened the eggs to get an embryological series. At first the egg shells were firm and quite taut, showing no indentations, but as development progressed the shell showed deep depressions here and there. On the 12th November I opened the last eggs that I had kept to hatch to establish the identity of the species. On this day the egg looked as though it was going bad, which was really the reason for my opening it. To my surprise, I discovered that it contained a nearly mature embryo, which would have come out in about four days to a week. Allowing ten days in the beginning and another seven days at the end this would give us an aggregate of 110 days (or three months and twenty days) as the incubation period.

Bombay Natural History Society,
Bombay. C. McCANN.
November 15, 1936.

XXVIII.—SNAKES' METHOD OF SWALLOWING PREY.

With reference to the remarks on the manner in which snakes swallow their prey in the very interesting article on the 'Snakes of Deolali' which appeared in the last number of the *Journal*, the following experience may be worth recording.

As I was passing a small pond some years ago, a large frog quite three and a half inches in length of head and body, leapt off the bank into the water and was instantly seized by the hindleg by a snake which had been lying in hiding behind a stone half in and half out of the pond. The snake was about two and a half feet long and of slender build, the head being little more than half an inch across at its widest. Though it looked a physical impossibility for it to swallow the frog, the snake had no doubts on the matter and retreating to its lair behind the stone, set to work. It had caught the frog about halfway down the leg, and it first worked its way back till the foot was in its mouth and then started literally to crawl outside its victim. The jaws worked alternately from side to side. Getting a purchase with the top jaw, there followed a violent heave until the lower jaw could grip a little further on, the two becoming entirely dislocated and the gape enormously stretched as it reached the thicker portion of the frog's body. The frog struggled violently until one leg was engulfed after which it seemed to become resigned to its fate and lay quite passive though still alive. Reaching the base of the first leg, the snake worked its way across the caudal region of the body and with considerable difficulty managed to double up and swallow the other hind leg. After that it was comparatively plain sailing though the gape and throat looked as if they might split at any moment. The whole process took about twenty minutes.

In this case the snake made no attempt to turn the frog round and swallow it head first. If it had tried to do so, it (the latter) would very probably have managed to break away, and it seems likely that most small, non-venomous snakes which devour their prey alive must swallow it as they catch it in whatever position it may be.

COOVERCOLLY,
SOMWARPET, COORG. F. N. BETTS.
January 8, 1937.

XXIX.—THE GIANT WOOD SPIDER.

I give below an account of the interesting behaviour of a species of small fly with a Giant Wood Spider (*Nephila maculata*) which is very common in the Coffee at this time of year. If you consider it worthy of record please publish it in the *Journal.*

During Coffee crop harvesting operations I noticed one of these spiders on the top of a Coffee bush having had its web torn down and was surprised to see a small fly crawling about one of its palpi. I watched to see what the spider would do to such a daring adventurer; but not content with its dangerous position the fly stepped on to the mandibles and put its head seemingly into the very jaws of its giant hereditary enemy. In a few seconds I was watching with even closer attention as the fly's abdomen was visibly swelling with the intake of some liquid and when about twice its original size the fly departed. Now what was the liquid imbibed from the lips of so formidable an enemy of all flies in general? Was I a witness to the equivalent, in the Arachnid tribe, to the African Crocodile Bird?

Further investigation may bring fresh light on the subject, but the fly being so small and easily overlooked there is remote chance of ever seeing such an interesting incident again. The spider took not the slightest notice of the fly, at anyrate did not appear to resent its presence. I was unable to see exactly how or from whence the fly sucked up the liquid as the nearer I moved my head the further the spider moved away.

NADUAR ESTATE,
VALPARAI P.O., S. INDIA.
January 20, 1937.
R. N. CHAMPION-JONES.

XXX.—NOTES ON THE MOULTING PROCESS OF THE SPIDER (*MYRMARACHNE PLATALEOIDES*, CAMB.)

(*With four text figures*)

Though it is generally believed that the spiders do not undergo any metamorphosis except the development of the palpal organs in the males after their final moult, yet a kind of transformation not only in the tarsal segment of the pedipalp of the male but also in the mandibles, teeth and fangs takes place in *Myrmarachne plataleoides*, Camb., and some other of *Attid spiders*.

Sometime ago I collected a specimen of *Myrmarachne plataleoides,* apparently a female, and put it in a glass tube. The next morning I was surprised to note a remarkable change in the contour of its body. The specimen had, by now, become a fully developed male, provided with the copulatory organs at the digital joints of the palpi; the cheliceræ being nearly half as long as the body. These characteristics were not at all noticeable on the previous day when the specimen was actually collected. This marked transformation led me to investigate the details of the moulting habits of this species of spider, particularly with reference to the changes that occur during the final moult.

Colour.—After emergence from egg, the young *M. plataleoides* looks yellow with a continuous black line over the anterior row of eyes. The young ones come out of the retreat after 5 or 6 days. They measure about 1 to 1·5 mm. in length. At this stage the dorsum of the cephalothorax is almost black with a slight yellowish tint. The anterior portion of the abdomen, both dorsally and ventrally, is orange or reddish-yellow in colour, while the posterior half is deep black. The cephalic portion is high and flat, but the thoracic portion slopes with a slight upward curvature in the middle; the abdomen is oval with a slight depression on the dorsum.

Moults.—Within seven to ten days after emergence from the retreat, the young spider changes its skin. The second moult takes place ten to fifteen days after the first, a slight depression appearing at the middle of the cephalothorax. The young spider now appears rather broader than long owing to the shortness of the pedicel. After the third moult, the body becomes elongated and assumes the form characteristic of the species. The blackish shade of the anterior portion of the body is by this time replaced by a reddish-yellow tint, while the region round the eyes retains the original blackish shade which persists throughout life. Two or three days after the fourth ecdysis, the abdominal black tint disappears within a few hours. An orange or yellow colour then becomes prominent all over the body with a few black specks on the cephalic region. The appearance or disappearance of markings or spots in the spider follows each fresh moult. After the fifth moult, the spider approaches the normal size of an adult, the colour becoming brick-red with distinct white markings on the dorsal aspect of the abdomen and on the sides of the cephalothorax.

Uptil the final moult (i.e. the sixth) all the immature forms resemble mature females, the sexes becoming distinct after the final moult. The habit, biology, external structures, size, colour and markings of the body and even the number and arrangement of teeth in the cheliceræ of the sex-undetermined immature forms are in all respects similar to those of the mature females. The tibial and tarsal joints of the pedipalpi of both mature and immature forms are identical. The distinction between the two sexes before the final moult is so negligible that immature specimens cannot be separated with respect to their potential sexes (Fig. 1).

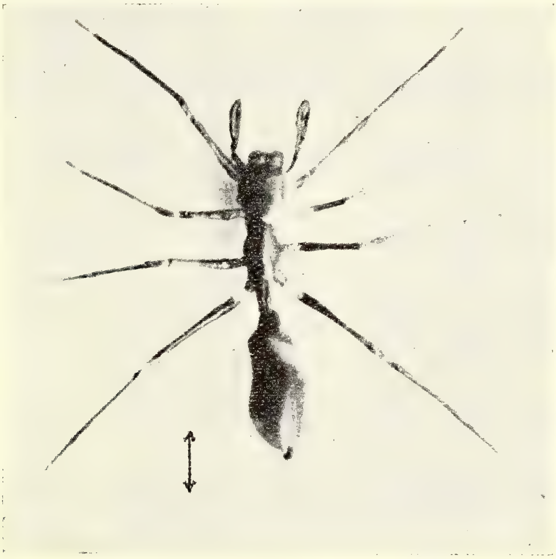


Fig. 1.—Enlarged photograph of a sex-undetermined specimen of *M. plataleoides*, after the penultimate moult.

Very striking changes take place in the immature forms of the male sex, (potential) during the final moult. Two or three days previous to casting off its last integument the immature spider spins an oval shaped retreat composed of loosely woven silk and rests quietly within it without taking any food. During the progress of moulting the spider attaches itself to the thread of the retreat by the claws of its legs. The old chitinous cuticula covering the dorsum of the cephalothorax is the first to give way laterally and is raised up like a lid hinged, as it were, to the posterior extremity of the cephalothorax (Fig. 2).

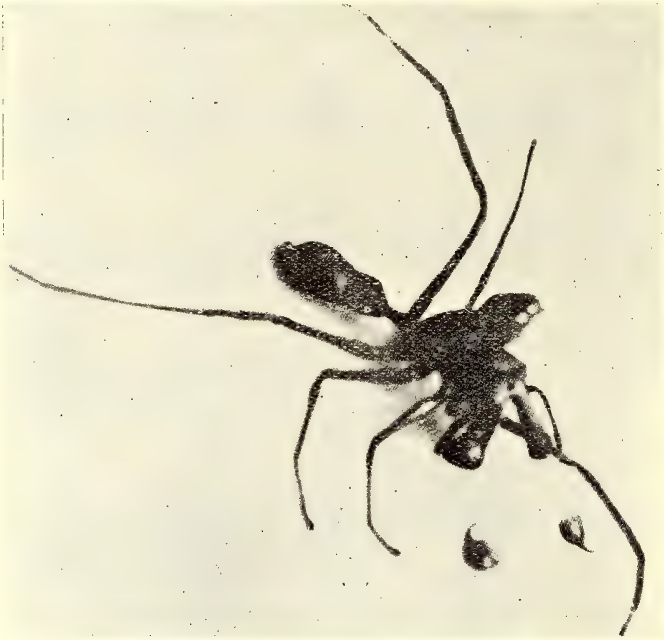


Fig. 2.—Enlarged photograph of the process of the final ecdysis of the apparent female of *M. plataleoides*. The cuticle of the cephalothorax is raised upwards and the minute mandibular cuticles are cast off (shown in front of it) and two club-shaped mandibles are seen in progress of growing.

The body then works itself out and the appendages are gradually disengaged from their exoskeleton. During this progress the chelicerӕ are drawn out from their old cuticle and undergo growth and transformation while still soft. The pedipalpi are then drawn out of the slough along with the first and second pair of legs. The palpi which were flat before the last moult become now rounded and provided with a copulatory bulb and a tibial apophysis or copulatory claw, as we might call it, since it plays an important part during the act of mating. When the newly formed dorsal shield of the cephalothorax has become exposed by the uplift of the old cuticle, a pair of stump-like bodies, which are flat on the upper and inner faces, appear to come out, from inside the original minute mandibular integument by pushing upwards (Fig. 3).

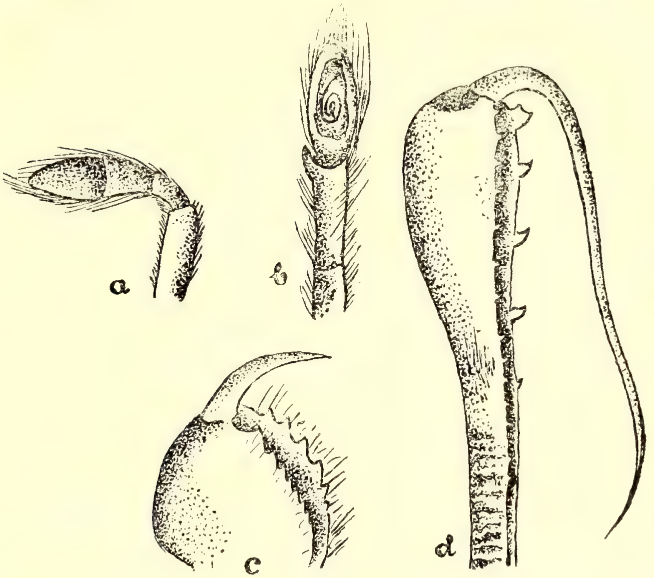


Fig. 3.—*a* External structure of the pedipalp of sex-undetermined specimen and adult female of *M. plataleoides*; *b* the pedipalp of the male after the final moult; *c* the chelicera of the sex-undetermined specimen of *M. plataleoides*; *d* the chelicera of male which grows out of a minute one as shown in *c* during the final moulting.

After a few minutes, globular swellings with rudimentary uncinate processes appear at the apices of these stump-like bodies. Gradually these swellings increase in length and project out in the same plane as the cephalothorax. As a result of this growth, the chelicera becomes half as long as the spider's body. The uncinate processes, which are articulated at the apices of the cheliceræ, gradually begin to show signs of rapid growth and extend as far as the bases of the cheliceræ. The length of the uncinate process equals that of the chelicera. The inferior ridge in the chelicera comes out of the old cuticle armed with about twelve to fourteen teeth, all of which are bent forward and placed at equal intervals throughout the whole length of the stem, while the superior ridge contains five teeth equally distributed in the fore half of the chelicera. The basal half of the chelicera, when viewed dorsally, looks transversely rugose and its extremity assumes abrupt enlargement, giving the spider much the appearance of a spoon-bill. Black spots, which are absolutely absent before the moulting, appear at the apices of the cheliceræ. The third and fourth pair of legs come out of the old cuticle almost simultaneously along with the abdomen (Fig. 4).

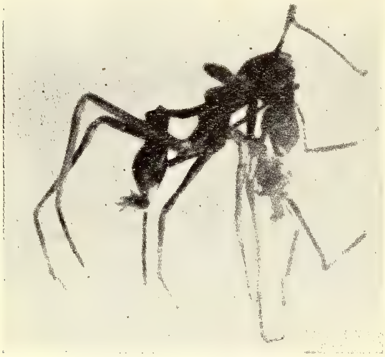


Fig. 4.—Enlarged photograph of the second stage of final moult of *M. plataleoides* (♂). Extrication of the abdomen and hind legs is in progress.

The whole process of the last moult is completed within half an hour or so. After the moulting is over, the spider takes rest for a considerable period of time during which the whitish colour of the body turns brick-red.

With the females, however, the armature of the epigynum characteristic of the adult females becomes fully developed after the sixth or final moult, and the colour of the atriolum becomes dark brown and conspicuous. The immature form of the female sex by this time becomes sexually mature.

A paper dealing with above in details will be published later.

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